CHEMICAL
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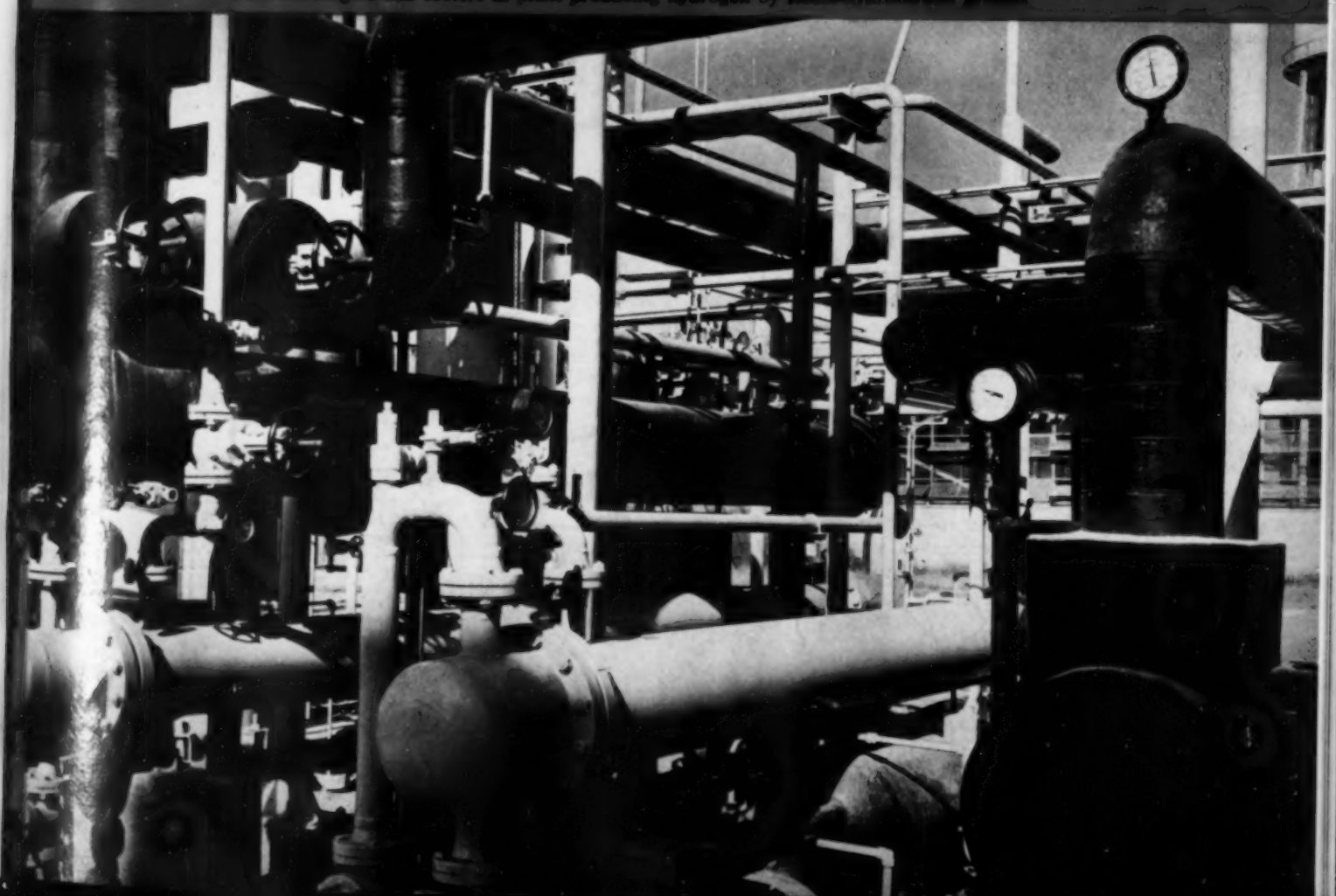
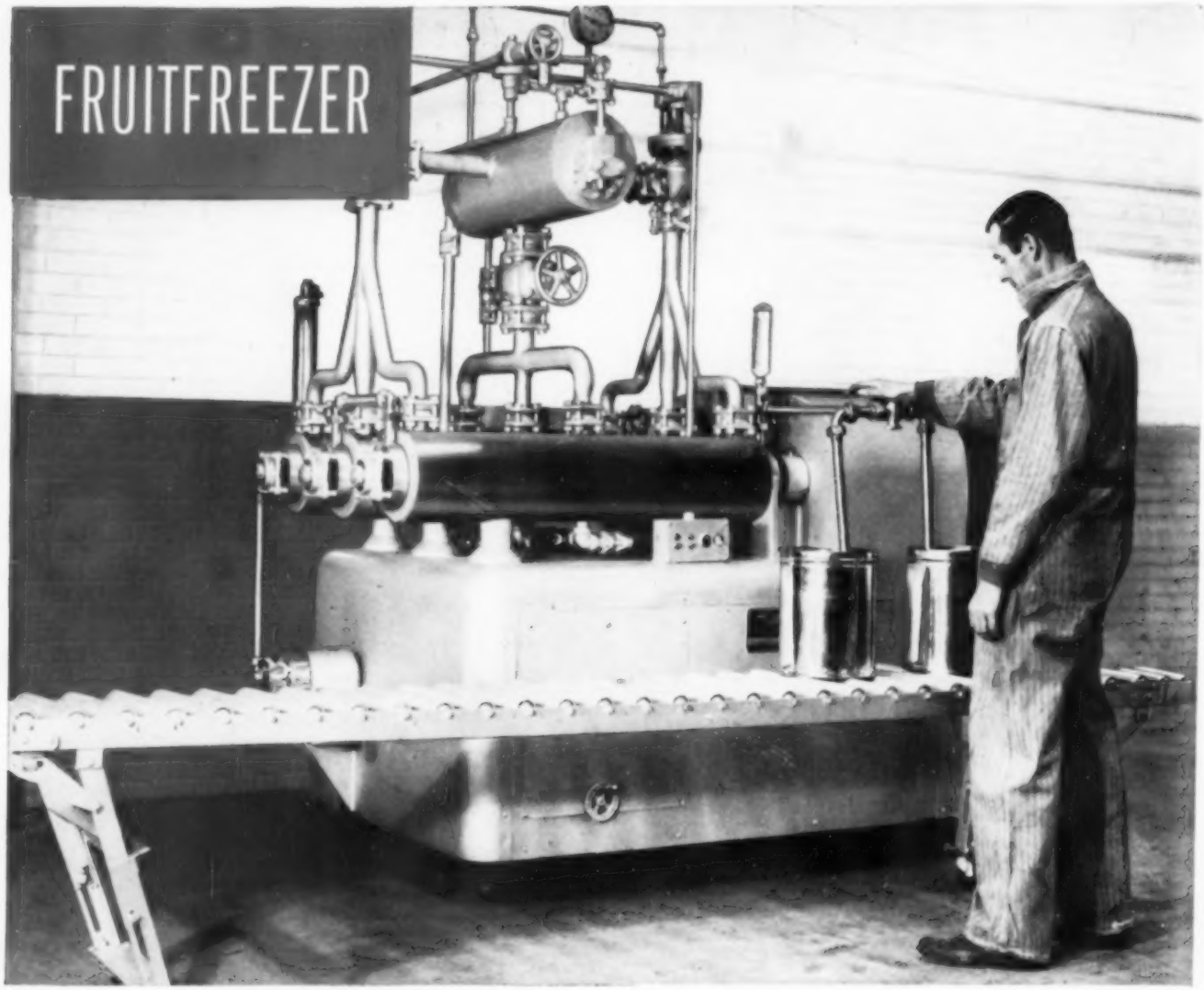
ENGINEERING

Heat exchangers and coolers in plant producing hydrogen by steam-hydrocarbon process





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In this Issue

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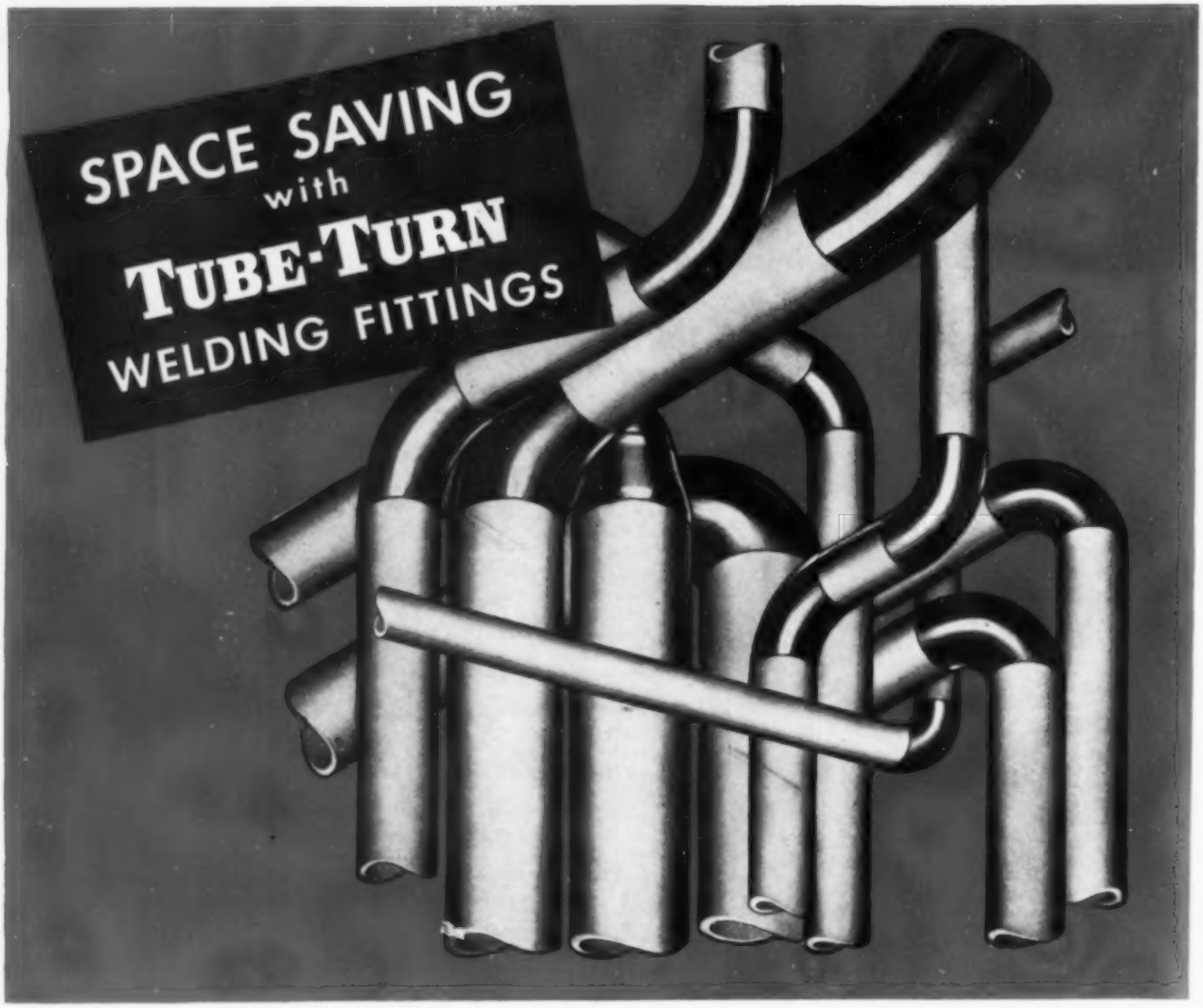

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ESTABLISHED 1902 MAY 1946 SIDNEY D. KIRKPATRICK, Editor

One Step Toward One World

A YEAR ago several hundred American chemists, engineers and technologists found themselves in London, working closely with their British counterparts in science and industry. We had a common objective in helping to win the war, and, we hoped, the peace that is yet to come. As we worked together we had our little differences and disputes, but there was always a sympathetic understanding and an ardent desire to carry over those Anglo-American friendships into the postwar world.

Lately there have been opportunities for many of us to renew some of those acquaintances and to strengthen already friendly relations with our chemical brothers from overseas. Sir Ian M. Heilbron, the distinguished professor from the Imperial College of Science and Technology, came from London with his gracious lady to receive at Atlantic City the 1946 award of the Priestley Medal of the American Chemical Society. The international president of the Society of Chemical Industry, Dr. Eric K. Rideal, who had recently been appointed to the chair in the Royal Institution once held by Sir Humphrey Davy and Michael Faraday, has been the honored guest of both the American and Canadian sections of SCI. Dr. D. W. Kent-Jones, the eminent English authority on flour milling, is here to talk to the cereal chemists at Niagara Falls, Ont., on the new extraction procedures in that industry. In July we are sending past president Wallace P. Cohoe to receive the Messel Medal of the SCI, while the American Section's honorary secretary, Cyril S. Kimball, is to become a vice-president of the parent society. Both of our nations, we hope, stand to benefit by this international exchange of science and scientists.

If we are to continue to contribute our share toward shaping a real community of interests in this troubled world, there is a big advantage in starting with the British. As President Rideal reminded us in New York last month, "the ties of a common language, a common law and a common philosophy are greatly strengthened when in addition we have ties of common interest in a common science." Certainly, the English-speaking peoples of the world now have their great opportunity to work together—not as clique against the rest of the world, but as a progressive force for international cooperation.

We have much to learn from each other. There can be benefit to both in blending some of our national characteristics. We like to think, for example, of American enterprise and risk-taking in technology and industry, and to contrast it with the caution and conservatism of the average British businessman. Yet so often, at least in our experience, we find the Englishman with the sounder concept of economics and the better knowledge of world affairs. A background of centuries of world thinking promotes the longtime viewpoint of the investor which compares none too favorably with the opportunistic, short-term approach of the gambler.

A wag friend of ours—an Englishman, too—remarked during his visit here that "America prospers from an economy of waste, while Britain suffers from a waste of economy." Perhaps this is just another way of saying that neither philosophy is most to be desired. Blessed with our great natural resources and other advantages of industry and trade, we can probably continue almost indefinitely to advance with our fast-moving and dynamic economy. But there may come a time, if it is not already approaching, when our very advances endanger our position in the rest of the world—when the best of our intentions are regarded with fear and suspicion. So we do have reason to ponder over the fact that the race is not always won by the swiftest and that it is very much to our own self-interest to see that we have strong, able and understanding friends. That, of course, is one of the reasons we favor the British loan.

JOHN B. TUTTLE and ERIC R. WOODWARD
Respectively, Chief Chemist, Theobald Industries, Inc., Kearny, N. J.; Chemical Engineer, Mathieson Alkali Works, New York

Sodium Chlorite Is Successfully Used for BLEACHING TALLOW

Bleaching tallow with sodium chlorite is based on the production of chlorine dioxide, a powerful oxidizing gas.[3,4] Commercially, this is done "in place" by adding chlorite and either of two activating agents to the kettle—

(1) Acid activation: $5NaClO_2 + 2H_2SO_4 \rightarrow 4ClO_2 + 2Na_2SO_4 + 2H_2O + NaCl$;

(2) Activation with chlorine gas: $2NaClO_2 + Cl_2 \rightarrow 2ClO_2 + 2NaCl$. Experimentally, dry chlorine is being generated outside the bleaching kettle, then bubbled through the hot tallow.[5]—*Editors*

SODIUM CHLORITE bleaching of fat has come into large scale use in the soap industry during the past year. This is due in part to the shortage which made it necessary to find some efficient means of upgrading low quality fats. Even more important, however, was the discovery that chlorite is of considerable value for bleaching available grades of tallow, such as the refined tallow (low free fatty acid) used for toilet soaps, and the type of tallow used in making laundry soaps and soap flakes.

Conical bottom of tallow bleaching kettle in plant of Theobald Industries; note chlorine tubing and connection

Traditionally, there has been some hesitation about the use of chemical methods for fat bleaching because of the fear that the iodine value and titre might be affected, thus lowering the soap-making qualities of the fat. To avoid this result, considerable color removal has been accomplished by absorption methods using materials such as acid-treated clay, fuller's earth, or activated carbon. When it was demonstrated[1,2] that chlorite can bleach wood pulp and textiles without attacking the chemical structure of these materials, interest was aroused in the possibilities of chlorite for bleaching fats and oils. Subsequently, it was found that similar chlorite bleaching methods could be used for tallow without causing chemical deterioration of the fat. Moreover, the bleaching of tallow with sodium chlorite greatly improves its odor.

REFINED TALLOW

Refined tallow for toilet soap manufacture is now commercially bleached by the use of both the acid-activation and chlorine-activation methods. The bleaching is carried out as follows.

The tallow as received from the rendering department contains some free fatty acid and must be refined. It is heated with steam in a hooded kettle to a temperature of 210-212 deg. F. Before the caustic soda is added it is desirable to shut off the steam and allow the excess water to settle so that it may be drawn off at the bottom. Enough caustic soda solution is then added to neutralize completely the free fatty acids. The strength of the caustic solution will vary with the percentage of fatty acids being removed, 8 deg. Bé being effective with low fatty acid. With increasing percentages of fatty acids, the strength of the caustic solution is advantageously raised to as much as 12 or 14 deg. Bé. Soap stock settles to the bottom of the tank and is removed. The refined tallow is washed with hot water and, after settling overnight, any remaining soap solution is drawn off from the bottom.

Acid activation—In the acid-activation process, the refined tallow is heated with steam to get a temperature of 210-212 deg. F. Agitation with steam is continued and 1 lb. of technical sodium chlorite is added per 1,000 lb. of tallow, followed by portions of a 20 percent aqueous solution of sulphuric acid until the water layer (which is equivalent to 10 percent of the weight of the tallow) in the kettle shows a pH of 4 or less. Brom-phenol blue (available in paper strips or in solution) is very convenient and sufficiently accurate as an end-point indicator. The transition from purple to yellow shows that sufficient sulphuric acid has been added to activate all of the sodium chlorite.

After pH 4 has been reached, steam agitation is continued for ½ hr. The water is again checked for pH value to guard against an unseen rise and at the same time a check on the bleaching properties of the water layer is made with starch iodide paper. The desired bleaching effect has usually been reached at this point.

Steam is shut off and the water content of the kettle is raised by the addition of small amounts of a weak caustic soda solution (8 deg. Bé) to a pH value of

approximately 8. The water settles to the bottom and is drawn off. The bleached tallow is dried and allowed to rest a short time so that small amounts of sludge may settle to the bottom where they can be removed. Failure to bring the pH value back to 8 may result in reversion of color in the drying or in subsequent action of the acid on iron tank cars.

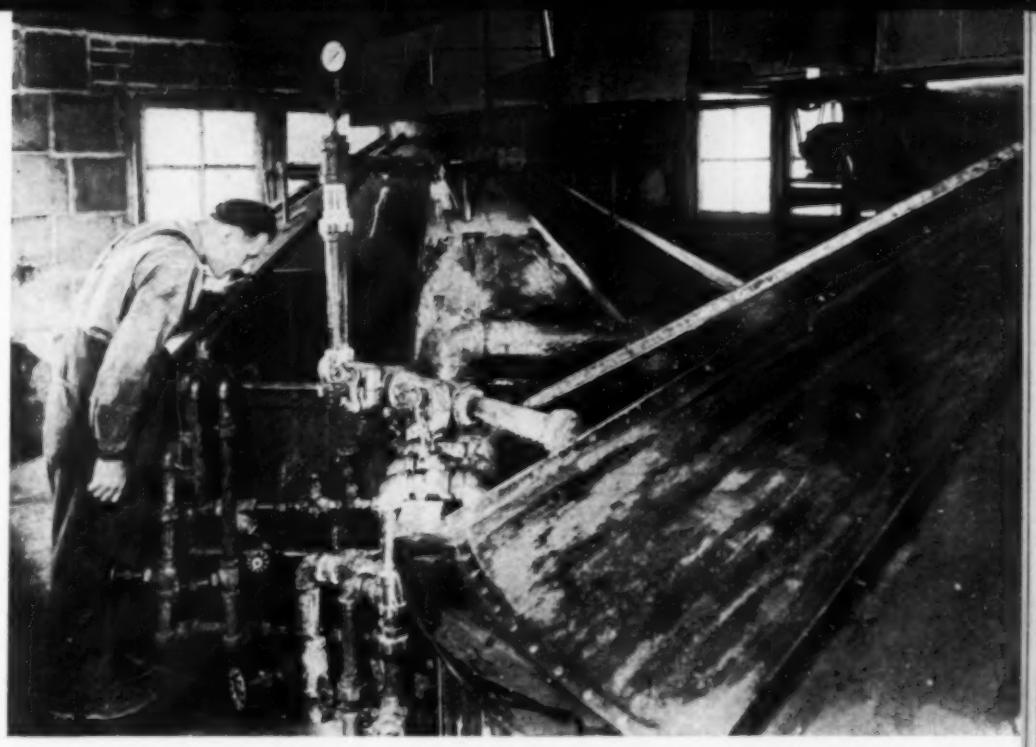
Improvement in the color of tallow is measured, according to the colorimetric scale set up by the Fat Analysis Committee of the American Oil Chemists Society, by the reduction of its "FAC number." With the chlorite process just described, the color change is as follows: Starting with tallow at 19-21 FAC, the color is reduced to 13-15 FAC after refining. After chlorite bleaching, the color is further reduced to 3-5 FAC.

This acid process gives excellent results, as indicated by the above figures, and has the advantage of being simple and requiring no additional equipment. However, the reaction takes place at a pH of 4 or lower and there is appreciable corrosion of pipes and valves.

Chlorine Activation—To avoid strongly acid reactions, bleaching of tallow may be done by the chlorine-activation method in accordance with the following example.

Tallow is first refined as in the acid operation. A 61,000-lb. batch of refined tallow is heated with steam to 210-212 deg. F. in a hooded kettle and enough chlorine gas is added to the water layer (again representing about 10 percent of the weight of the tallow) to lower its pH to 6. Then 0.1 percent by weight of sodium chlorite, based on the weight of the tallow, is added. The chlorite may be added as a 1-2-percent aqueous solution, or it may be more convenient to add the water first and, after 212 deg. F. is reached, add the determined amount of dry sodium chlorite. In the latter case, boiling is continued long enough for the chlorite to be dissolved and equally mixed with the tallow. Sufficient additional chlorine gas is added to complete the reaction of the chlorite. The total chlorine required is not more than one third of the weight of the chlorite used and the gas may be added in 40 to 60 min.

Chlorine addition is carried out in the following manner. Two 150-lb. chlorine cylinders are manifolded together and used simultaneously in order to reduce the rate of withdrawal from each to prevent freezing. The cylinders stand on a platform scale. The cylinder outlets are connected to a ¾-in. brass tee by means of ¾-in. copper tubing. From this tee a single copper tube goes to a 200-lb. chlorine gage and then to a second tee from which two lines branch out, one going to each of the two large kettles. Both kettles, however, are not used simultaneously. A ¼-in. threaded Hastelloy nipple is welded into each tank wall near the base of the cone. On this nipple is a ¼-in. Lunkenheimer needle valve with Hastelloy seat and stem. This valve is kept closed until chlorine pressure shows on the gage. Then the valve is opened and chlorine flows into the water layer at the base of the kettle.



Tops of kettles showing fume exhaust ducts, connections for steam and caustic soda; sodium chlorite is dumped in dry; steam is used for heating and agitation

When chlorine addition is completed, the chlorine valve at the kettle is closed and the chlorine supply is then shut off at its source. Agitation with steam continues for a total of 30 min., at which time the bleaching reaction has been accomplished. The total bleaching process is carried out in 1½ hr., which represents best practice. The process is carried out in ½ hr. elsewhere, but because of the speed with which the activating agent is added there is loss of chlorine dioxide from the top of the kettles.

Enough dilute caustic is added to raise the pH of the water layer just above 8. The tallow is dried and shipped at a stable FAC color of 3-5.

CRUDE TALLOW (BROWN GREASE)

At present, the only commercial application of chlorite bleaching used for crude tallow is the acid-activation process, carried out as follows: Tallow is heated to 210 deg. F. and treated with 1 percent by weight 66 deg. Bé sulphuric acid (1:1 with water), plus 0.1 percent sodium chlorite in a 10 percent aqueous solution. The mixture is agitated for 1 hr., then is heated to 220 deg. F. to remove moisture, treated at this temperature for 15 min. with acid-treated clay, and finally filtered. A color change from 41 FAC in the crude tallow to 13-15 FAC in the finished product is accomplished by this process.

Experimental work has shown that both brown grease and house grease may be successfully bleached with the chlorine-activation process.

DRY CHLORINE DIOXIDE

Preliminary experiments on the bleaching of tallow with dry gaseous chlorine dioxide, which is produced outside the tallow kettle by a chlorine dioxide generator and bubbled through the melted fat, have shown very promising results.

One batch of house grease was improved from 39 to 15 FAC in one step without refining, that is, without using water or introducing the sodium ion. If this method of bleaching proves successful as a final process, it will eliminate the need for washing and drying, thus greatly facilitating bleaching operations.

VALUE OF TREATMENT

The treatments discussed above have definite economic value because of the considerable improvement in quality which accompanies the lightening in color of the tallow, the lowering of its free fatty acid content, and the improvement in odor.

These facts suggest that renderers, as well as soap manufacturers who now bleach the tallow supplied them by the renderers, may find the chlorite treatment advantageous.

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JAMES G. PARK *Vice President, Standard Alcohol Co., New York, N. Y.*

SOLVENTS

Face Difficult Expansion Problems

In recent years production of alcohols and solvents has increased to a marked degree with a wide diversification in the kinds and types produced and with end uses developed in virtually every basic industry. Postwar capacities for some solvents have been reduced through the closing of government plants and shortages are in prospect with producers encountering complicated problems in determining where and how productive facilities should be expanded in order to meet full consuming requirements.—*Editors*

WHAT HAS happened in the way of growth in the solvents industry may be illustrated by recalling that prior to World War I, with the exception of petroleum hydrocarbons, the only solvents commercially available were wood distillation methanol, ethanol, ethyl acetate, methyl acetate, and ethyl ether. At that time production of all these solvents amounted to only a few million pounds a year whereas it is probable that 1946 will see a total solvents output in excess of 2.8 billion pounds.

It is not merely in volume of output that the solvent industry has made progress in the last 25 years. A review of developments for those years also emphasizes the large increase in the kind and type of solvents produced. The work of the chemist and the chemical engineer has been responsible for a transition from a situation where the solvent user had to adjust his production problems to available solvents to a present situation where the manufacturer of synthetic chemicals is producing special solvents to meet specific consumer requirements. Then too the last quarter century has brought wide diversification in the outlets for solvents. End uses have been developed in virtually every basic industry. Hence solvent production is very sensitive to the economic trends of the country and may be considered a fair barometer of general business conditions.

As a number of competing solvents are produced both synthetically and by fermentation, the industry has been the proving ground for endless debate on the merits of minerals or agricultural products as preferential sources for chemical raw materials. During the past decade, there has been encountered nearly every phase of experience which can contribute to the passing of final judgment on this question.

PRODUCTION COSTS

In the early twenties when the solvent business was based almost entirely on fermentation, production costs were tied up directly with prices of the agricultural raw materials. In the depression years prices for farm products were very low and with this advantage the fermentation industry was able to maintain its position in the face of newly created competition from synthetic production. Throughout the recent war years production of solvents in quantities large enough to take care of urgent requirements was of paramount importance with production costs and selling prices secondary. Hence producers went through the phenomenon of a dual pricing system with a relatively high official ceiling for solvents produced by fermentation and a low price for those produced synthetically. Under this system of price and distribution controls the element of competition was removed and each branch of the industry played its full part in aiding the war effort.

With the cessation of hostilities, the alcohol and solvent business was immediately subjected to the strains of an inflated economy with the result that products obtained by fermentation increased in cost while the prices for synthetic solvents remained at the fixed levels of the war years. As synthetic productive capacity is not large enough to fill more than a part of total requirements and fermentation solvents are selling at prices as much as 100 percent over the ceilings placed on synthetics, producers of each type are now confronted with the problem of whether or not they should expand and, if so, how.

Postwar conditions not only have not been conductive to expansion of fermentation production but actually have forced curtailments since the shortage of foodstuffs has brought government restrictions on the use of grains and other agricultural products as raw materials for industry. Whether synthetic production will come in for immediate or nearby expansion—and if so, how much—seems to be bound up in finding correct answers as to whether: the hump of inflationary trend has been reached, how long the world food shortage will continue and when some of the political factors contributing to this shortage will be settled, whether the present confusion has been neutralized—whether we are entering the relatively long period of peace and economic development—or whether we are merely having an armistice to prepare for the third phase of international conflict. These questions are of greater magnitude than any of the problems directly connected with the solvent business and no plans for expanding capacities for manufacturing solvents can be justified without at least a partial answer to them.

The changes which the last 25 years have made in the solvent industry are greatly emphasized in the case of some of the individual products. At the end of World War I, the only methanol available was the natural product made from the distillation of wood. Prices for natural methanol were unstable

PROBABLE 1946 PRODUCTION OF ALCOHOL AND SOLVENTS

Combined alcohols	**2,000,000,000 lb.**
Ethers	**12,000,000 lb.**
Acetates	**300,000,000 lb.**
Ketones	**400,000,000 lb.**
Glycols	**100,000,000 lb.**
Total	**2,812,000,000 lb.**

sometimes fluctuating as much as 100 percent within a few months. This had the effect of checking attempts to develop new outlets for methanol as no industrialist could plan on using it regularly as a raw material. Hence its use was limited largely to denaturants and anti-freeze compounds as such usage made it possible to pass on frequent price fluctuations to the consumer without limiting the market.

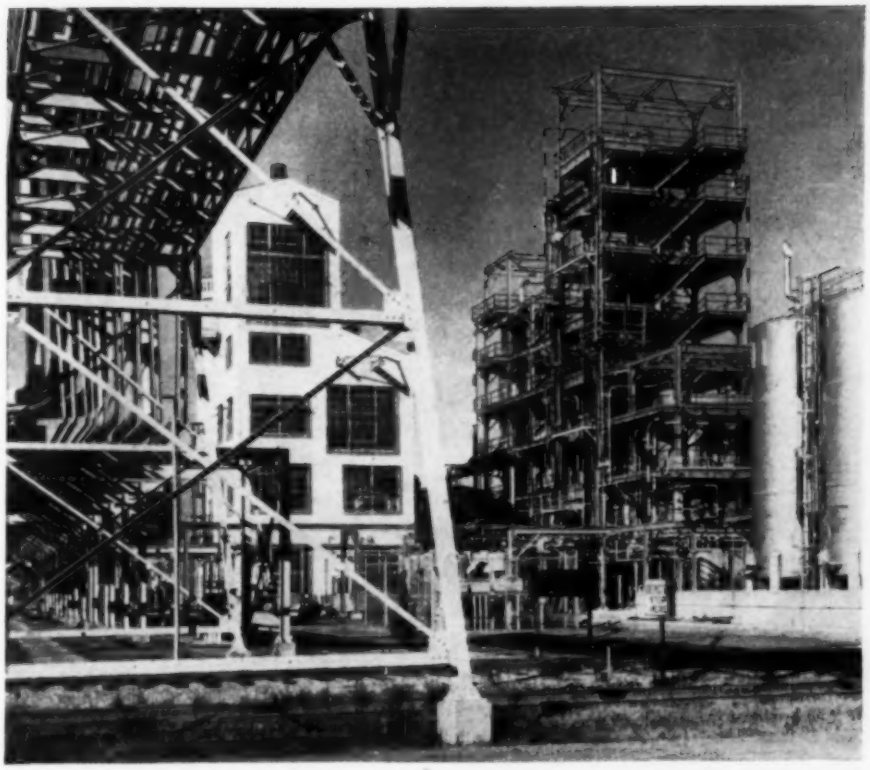
SYNTHETIC METHANOL

In 1923 synthetic methanol was produced for the first time commercially in the United States by high-pressure synthesis using hydrogen and carbon monoxide as raw materials. What this development did for the chemical industry in general may perhaps best be illustrated by saying that from the zero point in 1923, domestic production of synthetic methanol had grown by 1945 to approximately 70 million gallons turned out in private plants with about 30 million gallons additional being produced in government facilities. In that same period the output of natural methanol has continued pretty much in the range of 5 to 6 million gallons a year.

When manufacturers of chemicals were assured of a constant source of synthetic methanol at a fairly uniform price, it was not long before research work was in progress and chemical and engineering knowledge and skill soon developed many new processes involving the use of methanol as a raw material. The greater part of this development work was directed toward enlarging the field of methanol in synthetic resins and plastics, glycols, and a number of miscellaneous derivatives. All these were products which had been growing rapidly in favor and when the war was over, the heavy backlog of civilian demand for these products by the end of 1945 placed a heavier tax upon methanol producers that they had felt at any time during the war.

Difficulty in filling all requirements for methanol has demonstrated that present private productive capacity is not sufficient to satisfy the country's needs. Producers, therefore, are faced with the problem of bringing capacities up to the level of full requirements and more particularly with the problem of whether this expansion shall be accomplished through the purchase of the ordnance plants which produced methanol during the war years.

The agencies which have the responsibility for the disposal of these government plants have been reluctant to sell them below cost and they still are listed as surplus property. Present producers undoubtedly have been reluctant to acquire them, fearing that such action would subject them to the accusation that they were acquiring a monopolistic position. New capital has been timid and slow to act partially because of the restrictions placed by the government disposal agencies on the operation of the plants and partially because of the fear that deflation with its declining markets might arrive before the investment could be sufficiently liquidated.



Alcohol plant at Baton Rouge, owned and operated by Standard Oil Co. (N. J.)

Whatever the reasons or combinations of reasons for the failure to utilize government productive capacities, the fact remains that so far this year only private plants have been in operation and private plants can not produce enough for all needs. Hence 1946 will witness a market for methanol so tight that not only is there a danger of insufficient anti-freeze being produced but plastic manufacturers may have to curtail operations which undoubtedly would be a retarding factor in the country's reconversion program.

ETHYL ALCOHOL

Both the producer and consumer of ethyl alcohol are struggling with the dilemma of increasing markets and declining production. Whereas 25 years ago all ethyl alcohol was made from grain and molasses, today virtually three-quarters of the existing production is being supplied by synthetic plants. This condition has been brought about largely by the price situation. Over a long period ethyl alcohol from fermentation has ranged from 17 to 53c. per gal. and such wide fluctuations discouraged its use in many manufacturing processes. However, synthetic ethyl alcohol, which was first produced commercially in 1926, has not exceeded 26.5c. per gal. and has sold considerably lower when the market was under competitive influences.

Because of this steady price, it was possible before the war for chemists and chemical engineers to utilize ethyl alcohol to develop new processes for making acetic anhydride and other manufactured products. As a result of these developments, it is estimated that during 1946 and 1947 the alcohol equivalent of acetic anhydride going into cellulose acetate alone will amount to 50 million gallons of ethyl alcohol per year, which is one-half of the largest quantity ever produced by the fermentation industry. The fact that there still is a substantial quantity of alcohol produced from fermentation, in spite of a high price, indicates that demand for ethyl alcohol has not reached a saturation point.

Recent restrictive orders, however, which were put on the use of grain for alcohol, including butyl, combined with a shortage of molasses will mean that there will be an acute shortage of ethyl alcohol in 1946, and possibly in 1947. Up to the present time, the alcohol producers have been getting 60 percent of their alcohol from grain and molasses and have purchased the other 40 percent from the RFC stockpile. However, as Rubber Reserve is short of butadiene, it has reopened the alcohol butadiene plant at Institute, W. Va. and is drawing on the government stockpile of 80 million gallons to produce sufficient butadiene to meet the rubber program. The alcohol thus used will not be available for the alcohol producers and the shortage will grow more acute with the stress placed on new production.

As predictions cannot be classed as more than considered opinions, prophecies regarding the trend of the ethyl alcohol market for the next few years must be considered in the light of the questions raised earlier

in this article. If the world food shortage continues, the conclusion is inescapable that production of ethyl alcohol by fermentation will decline.

As the demand for alcohol will undoubtedly increase, the gap can be met only in one of three ways:

1. Increase synthetic alcohol production.
2. Produce by other methods some of the chemicals which are derived from ethyl alcohol. For example, make acetic anhydride by oxidation of petroleum hydrocarbons or from acetylene, and ethyl chloride by the chlorination of ethylene. Ethyl alcohol, in many cases, acts only as a carrier of ethylene. Not more than 18 percent of it is sold as ethyl alcohol for solvent uses.
3. Substitute other alcohols such as isopropyl and methyl for ethyl alcohol for solvent purposes.

So long as grain is scarce as a result of a world food shortage, molasses will be in demand at higher prices as cattle food in the United States as well as in world markets. The Cuban government also is utilizing substantial quantities of molasses to make alcohol for use in motor fuel. This has a sustaining effect on the molasses market. If it could be assumed that raw materials for producing alcohol by fermentation will remain scarce, and consequently expensive, the conclusion would be that synthetic plants would be expanded, and possibly new producers would enter the field. However, the probability that food will again become abundant makes investors hesitate to build synthetic facilities which are relatively expensive. Added to this deterrent to synthetic ethyl alcohol expansion, there are OPA ceilings which require that synthetic alcohol be sold at half the price of fermentation alcohol. There is a good deal of doubt as to whether substantial synthetic expansion will materialize.

The potential synthetic producer must consider present building costs. If the hump of the inflationary trend has not been reached, then synthetic plants built today may prove a good investment. If the gamble on inflation is eliminated, however, there is still a question as to whether at present material values and labor rates, OPA price ceilings cover cost of synthetic alcohol and also permit a normal business return on present day plant construction costs. A further uncertainty is the possibility of strikes and slow deliveries of material which may delay the time in which a new plant can be built until it is too late to be of service in alleviating the present critical shortage. Because of these factors, it is doubtful whether there will be a great expansion of synthetic plants except under special conditions.

The question naturally arises, if fermentation alcohol is not available and synthetic production is not increased—or if so, slowly—where are the consumers to obtain alcohol? The only conclusion is that they must turn to other alcohols. And in making a selection from the various types which are available, the one that comes closest to ethyl for most uses is isopropyl.

ISOPROPYL ALCOHOL

Isopropyl alcohol came on the market in commercial volume in 1920 and from a small beginning has gained steadily in importance with current annual production at approximately 70 million gallons. Production data for recent years are available from official sources. The totals are given in pounds and a review of the official figures shows that from an output of a little more than 131 millions pounds in 1937, domestic production of isopropyl increased every year with the 1944 figure given at 523 million pounds or just about four times the 1937 total.

The greater part of isopropyl alcohol production is consumed in making acetone. The Chemical Unit of the Bureau of Foreign and Domestic Commerce is authority for the statement that in 1944 production of acetone from isopropyl alcohol amounted to 328,428,000 pounds with additional 56,386,000 pounds produced by fermentation.

Isopropyl alcohol also is used in the manufacture of other chemicals and to a considerable extent in anti-freeze preparations. More recently it has been finding wider application as a solvent in the protective coating industry as well as in the drug and cosmetic trades. It can fill in quite widely where it has been customary to use ethyl alcohol and where current and future supplies of ethyl may not come up to consumer needs.

Referring to some of the other solvents it is found that acetone, which expanded from 100 million pounds in 1941 to 384 million pounds in 1944 and dropped back to 351 million pounds in 1945, is one of the chemicals whose use in the United States is expected to show immediate decline.* However, acetone produced from fermentation has been curtailed and also there has been an unusually large export demand which factors have tended to offset the decrease in the United States demand and to strengthen the market. The synthetic textile industry has increased, rather than decreased, and the demands for acetone in this field will not lessen. In general, acetone should be in good demand throughout the current year and possibly will have wide distribution throughout 1947.

The class of solvents which will give the most trouble during the reconversion period will be higher alcohols and acetates. As the grain situation, previously discussed, affects butyl alcohol produced by fermentation, a decline in production from grain is inevitable. Plans have been made for an increase of synthetic production, but actual production has been considerably delayed. Outlets for butyl alcohol are in industries such as automobiles, refrigerators, radio cabinets, etc. in which there is expected to be a large consumer demand for the next few years. The needs will equal or exceed production.

For higher alcohols, such as amyl, hexyl, and octyl, the demand has already exceeded production. One of the synthetic producers is now offering methyl amyl alcohol, which will help considerably.

Secondary butyl alcohol and acetate will be in short supply. The greater part of the secondary butyl alcohol production is diverted to the manufacture of methyl ethyl and higher ketones.

Methyl ethyl ketone producers are operating at capacity. Methyl isobutyl ketone, due to shortage of normal butyl acetate, has been in active demand and will undoubtedly find a ready market until such time as normal butyl acetate becomes easier. A number of other higher ketones have been developed during the war and will undoubtedly become more and more available.

In predicting the trend of the alcohol and solvent market, not only for the balance of 1946, but for a few years ahead, a few inescapable facts present themselves. It is obvious that with a large part of the world actually faced with starvation, agricultural products will not only be scarce but expensive, so that fermentation producers will unavoidably lose position.

As has been indicated in the beginning of our discussion, a trend came about during the war for synthetic manufacturers to develop new solvents to meet definite needs. The development of new resins and plastics will undoubtedly require newer solvents so that the solvent business should continue to expand during the coming years. As a result of this demand, traditional solvents will not increase as much as they have in past years, and may even decline. If the market for these newer solvents continues to develop and if they can be made available, the solvent business still should be capable of considerable expansion.

Production of Alcohol and Specified Solvents, 1939–1945

Year	Ethyl Alcohol[1] 1,000 gal.	Isopropyl Alcohol[2] 1,000 lb.	Butyl Alcohol[2] (n.p.) 1,000 lb.	Methanol[2] (Synthetic) 1,000 lb.	Glycerine[3] Crude 100% 1,000 lb.	Acetone[3] 1,000 lb.	Ethyl[3] Acetate 85% 1,000 lb.
1945	220,000[2]	[4]	129,275	491,460	172,451	351,422	103,654
1944	569,000	523,000	150,320	473,299	199,834	384,000	108,181
1943	437,000	376,065	128,999	431,321	171,933	347,624	103,600
1942	297,000	351,952	126,190	413,964	177,435	338,157	86,542
1941	217,000	260,180	129,472	371,096	195,283	259,064	94,690
1940	126,000	219,925	100,413	[4]	157,856	201,506	75,369
1939	103,000	179,062	66,904	226,746	147,581	91,918	67,897

[1] From War Production Board. [2] Total for first six months. [3] Data from U. S. Tariff Commission. [4] Figures not yet available. [5] Bureau of the Census.

E. I. STEARNS *Research Department, Calco Chemical Div., American Cyanamid Co., Bound Brook, N. J.*

How Chemical Engineers Can Use STATISTICAL METHODS

Don't overlook statistical methods. They can be used to advantage. Chemical engineers, however, needn't be expert statisticians. Like many other tools, only a basic understanding of a few fundamental principles is required for effective use. The author defines these principles and outlines some applications. ***Editors***

WHEN a man moves into a new home he will sometimes find that next door is a little girl ten years old who delights to wear rompers, sit on the curb, and make mud pies. The man becomes so engrossed in his business affairs that he pays no further attention. Suddenly, about six years later he glances next door again and is amazed to see a charming debutante. The little girl has grown up.

Somewhat the same thing has happened to the chemical engineer. Ten years ago there was a sister science known as industrial statistics. She was a modest little thing in pig-tails and the chemical engineer had many more important things to pay attention to than her. Suddenly, today, the engineer looks around and finds that the appreciation

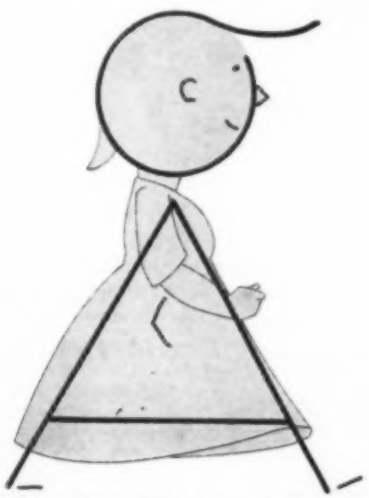


Fig. 1—Miss Statistics embodies two important statistical terms, *A* represents the average while σ (sigma) represents standard deviation

of the power of modern statistics is growing rapidly in industry. He concludes there must be something attractive in her. He would like to get acquainted with her and see what the attractions are for himself.

The purpose of this review is to furnish an introduction. Miss Statistics, meet the chemical engineer. (See Fig. 1.) Perhaps the two parties may enjoy close comradeship hereafter to the mutual benefit of each. The best way to become familiar with statistics is to talk to a statistician. There are two societies that are just overflowing with statisticians all eager to talk about the subject and welcoming guests at their meetings. One is the American Statistical Association* and the other is the Society for Quality Control.† There are many books on the subject. A bibliography compiled recently by the Library of Congress listed 362 of them. At the end of this discussion a list of nine books is presented (apologies to the 353 not listed). If the chemical engineer is interested in statistics it is hoped that the references to the two societies and the nine books will foster the friendship.

WHAT IS STATISTICS?

Statistics is mathematics applied to observational data. A fundamental concept, which is absolutely necessary to an understanding of statistics, is that there is such a thing as variation. A surprising number of non-technical executives believe that a number is an exact evaluation of something. This idea originates from the process of *counting*. Things that are counted such as bank balances and sheep are exactly expressed by a cardinal number. The chemical engineer is more often concerned with the process of *measuring*. Things that are measured such as length, time and viscosity are usually expressed as decimal fractions. A measurement is a scientific estimate of a quantity. Estimates are subject to variation. Hence the technical data of the chemical engineer are necessarily subject to variation.

If the chemical engineer always obtained exactly the right answer he would have no use for statistics. Imagine the following hypothetical case. He takes one gram of powder from his ten ton batch and it is exactly like every other gram. It is analyzed by the laboratory and the purity reported to many decimal places. There is no use checking because the analysis is perfect and a second test would yield an identical result down to the last decimal place. This happens to be the yield at an exactly known temperature. Combining this result with an earlier result he substitutes in the theoretical equation relating purity to temperature and gets the true value of the constants of the equation, thereby enabling him to predict purities at any temperature.

This pipe-dream is unfortunately only Utopian nonsense. Every sample, every analysis, every correlation is only an approximation. As more and more data are available this approximation approaches the truth, but samples do vary and analyses are subject to error.

As an analysis is repeated over and over again, with the result expressed to enough decimal places and with the analyst trying to get the same answer every time, the answers will cluster around the average, most being very close and a few being very different. When a plot is made of the number of times a particular answer is obtained versus the magnitude of the answer, a curve similar to that shown in Fig. 2 is obtained. This is a so-called "normal" curve. Other distributions can occur, and the statistician takes this into account. As a first approximation, however, the chemical engineer can deduce many

* The American Statistical Association was formed in 1839. Its purpose is to apply statistical methods to practical problems, develop more useful methods, and improve basic statistical data. It publishes the Journal of the American Statistical Association. Additional information may be obtained from Lester S. Kellogg, secretary, 1603 K St., N.W., Washington 6, D. C.

† The Society for Quality Control was formed in 1945 to serve all those interested in quality control, giving particular attention to those engaged in manufacture and inspection. The Society expects to publish material and has a capable editorial board. Additional information may be obtained from Ralph E. Wareham, secretary-treasurer, 305 East 43rd St., New York 17, N. Y.

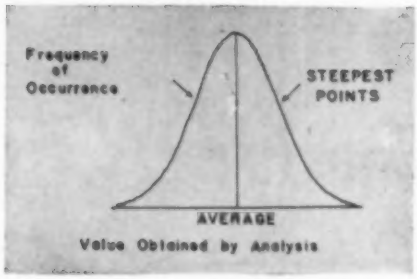


Fig. 2—Variation of chemical tests where normal distribution applies

reasonably certain conclusions by assuming a normal distribution.

This plot (Fig. 2) is characterized by two things of great importance, one is the average A, the other is the standard deviation σ (sigma). These are discussed below.

TWO STATISTICAL CONCEPTS

In order to confound the average statistician the chemical engineer has only to speak his normal language and use such well-known terms as azeotropic, entropy, etc. Similarly, to confound the average chemical engineer the statistician has only to use the well-known (to him) terms such as kurtosis, homoscedastic, etc. However, it is amazing how well the engineer may become acquainted if he uses only two statistical terms, the average and the standard deviation.

The average is known to most engineers, although it is surprising how often a production man, given two analyses of a batch such as 95 percent pure and 97 percent pure, will choose the higher value rather than the average as representing the truth. The mathematical calculation of the average is given by

$$A = \frac{\Sigma X}{n}$$

where A = average, Σ = summation sign, X = an individual datum, n = the number of data.

There are several ways to approximate the average. One is to take the highest and lowest value and divide by two. Another is to strike off the highest and lowest data alternately and take the last value. However, the above formula does not represent much calculational work and often gives the best answer.

As the number of observational data are increased the calculated average will deviate less and less from the true average. Hence the average is a good estimate of the true result and in many chemical engineering questions is the desired value. It is true that in some cases the average is not wanted (see Fig. 5). For instance, the strength of a chain is not equal to the strength of the average link.

The *standard deviation* is a measure of the randomness of the data. In Fig. 2 it is half the distance between the two points where the curve is steepest. If the analysis is poor the data do not cluster so closely to the average and the standard deviation is large.

The standard deviation is calculated by the formula

$$C_2\sigma = \sqrt{\frac{\Sigma d^2}{n}}$$

where σ = standard deviation, d = difference between an individual value and the average, n = number of such differences, C_2 = a correction factor (see reference 8) which varies with the number of data and is approximately equal to $(n\text{-}0.8)/n$.

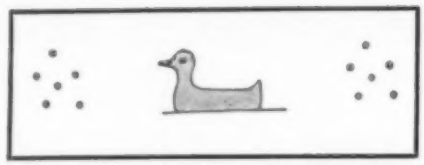
The standard deviation may be approximated in several ways. One is to subtract the highest and lowest value and divide the difference by an appropriate factor (see reference 7). Another is to multiply the average deviation by

$$\sqrt{\pi}/\sqrt{2} = 5/4 \quad \text{whence}$$

$$\sigma = \frac{5}{4}\,\frac{\Sigma d}{(n - 0.8)}$$

The saving in computational work may make this latter method appeal to some.

Three types of problems may be aided by application of statistical methods. These are as follows: Presentation of data, determination of the reliability of data, and quality control.



A hunter fired both barrels of a shot-gun at a duck. The first hit two feet in front, the second hit two feet behind. On an average the duck was dead. What he really wanted was meat on the table. In duck hunting one wants to keep trying until a single shot hits the mark. But in estimating purity by a chemical test the best estimate is usually the average.

Fig. 5—On an average the duck was dead

Table I—Two Ways of Presenting Experimental Data

(Not Recommended) Experimental Results					(Recommended) Experimental Results
20.0	22.2	18.1	20.5	19.5	n = 50
20.5	18.8	20.0	19.7	20.4	A = 20.0
19.2	20.1	19.6	20.7	20.1	σ = 1.0
19.8	20.3	21.3	19.4	19.4	
21.2	18.9	19.8	20.0	21.1	
19.2	21.6	19.3	20.8	21.4	
20.6	20.0	20.4	19.9	20.7	
19.9	21.0	19.6	19.7	18.5	
20.2	18.3	20.2	19.1	20.0	
19.0	17.5	18.7	21.8	20.9	

APPLICATIONS

An excellent manual on *presentation of data* has been put out by the American Society for Testing Materials. Their recommendation is that as a minimum the average, the standard deviation and the number of data be presented. Examination of Fig. 2 will show that the average is the measurement most often obtained, that measurements deviating only slightly from the average occur more frequently than those with large deviations, and that positive and negative deviations are equally likely. Hence the average is fundamental to an understanding of the data. However, the average of a series of experimental or measured values does not yield all the information. A good deal more is contributed by the standard deviation. This indicates the precision of the measurement and tells how wide the frequency plot is.

An example will show the effectiveness of this method of presenting data. Table I presents some experimental results. The three most pertinent questions, how many tests were run, what is the true result and what variation is to be expected are imme-

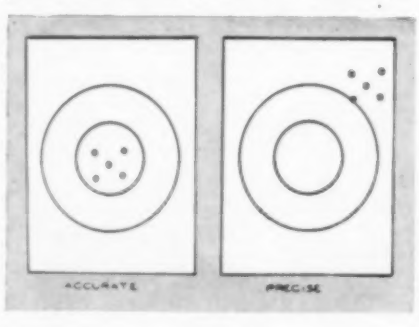


Fig. 8—Don't confuse precision and accuracy

The shots on both targets are precise, that is, they are bunched together. But only the shots on the left target are accurate. The shots on the other are away from the bullseye and are said to be subject to a systematic error. Consistent results are not necessarily true results. In the case of some triphenyl methane dyes, precision is more important than accuracy. Some of these dyes are not pure but contain closely related isomers. A stoichiometrical calculation gives inaccurate results because of this. But for comparison with standard, precision is satisfactory.

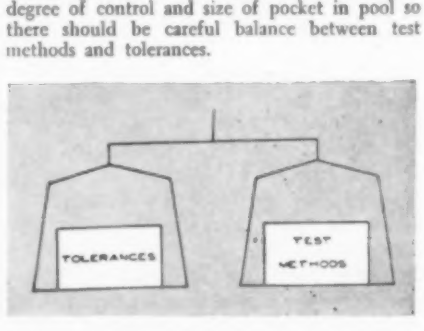


Fig. 7—Careful balance should be maintained between tolerances and test methods to obtain best results

Pocket pool is a popular game. This is because the pockets are four inches wide. If they were narrower, it would be so hard to sink the balls that few would play. If they were wider, so that anyone could score on every shot, few would play. In pool the problem is to apply a control on the cue ball, and get the eight ball to drop in the specifications of the corner pocket. In plant work, by applying controls and testing, an effort is made to direct products within their specifications. Just as there is a careful balance between degree of control and size of pocket in pool so there should be careful balance between test methods and tolerances.

Editor's note—Figs. 5, 6, 7, and 8 are taken from Calco Technical Bulletin No. 773 entitled Statistical Analysis of Test Data, by E. I. Stearns, Research Department, Calco Chemical Div., American Cyanamid Co., Bound Brook, N. J.

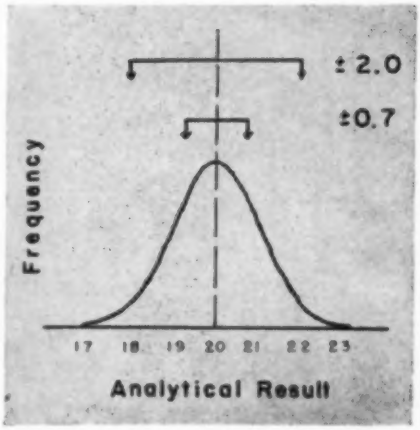


Fig. 3—The values ± 2.0 and ± 0.7 may both be used to describe the same precision of measurement

diately answered by the recommended values, n, A, and σ if one has the concept of Fig. 2 in mind. (See also Fig. 6.)

The *reliability* of data may be expressed with the assistance of the standard deviation. Fig. 3, is a plot of the standard deviation. Quantitatively, it is customary to express deviations from the average in terms of multiples of the standard deviation and statistical tables have been prepared giving these values. For the normal distribution of Fig. 3, approximately one-third of the measurements differ from the average by more than the standard deviation. Consequently, an exact statement of the reliability of a measurement is the value of σ. Some chemists like to express results as limits of error. Twice the standard deviation, which includes about 95 percent of all the measurements, may be used for this. The first datum of Table I would then be given as 20.0 ± 2.0 (twice the standard deviation). On the other hand, some chemists prefer the probable error, perhaps because it makes their published data look more precise. This is the greatest error by which the more precise half of the measurements will deviate from average. The probable error is about $2\sigma/3$. The first datum of Table I would then be given as 20.0 ± 0.7 (probable error). To avoid misunderstanding a definition of "limit of error" should be included with any such + and − value.

When a number of measurements are made, the average value has a precision ex-expressed as standard deviation of $\sigma/\sqrt{n}$. When two results are compared, the precision of the difference is found by $\sqrt{\sigma_1^2 + \sigma_2^2}$. When two experimental values x and y are multiplied, the precision of the product is $\sqrt{y^2\,\sigma x^2 + x^2\,\sigma y^2}$. By means of equations such as these, precision of chemical engineering data can be determined even if they have been arrived at by calculation.

The concepts of average and variation are of great importance in *quality control*. The ASTM and ASA both have good and brief presentations of this subject (see references

3.14159265358979323846
26433832795028841971
69399375105820974944
59230781640628620899
86280348253421170679
82148086513282306647
09384460955058223172
53594081284811174502
84102701938521105559

Pi is expressed to 180 decimal places in the figure above. Some time back the French Academy of Science was working out the value of pi. A carpenter heard about it, cut out a circular piece of wood, measured the circumference with his tape and mailed in his answer, 3.1. This seemed funny to the Academy, since at that time they knew the value to 200 decimal places. But the carpenter had one very good point. He expressed his data to only as many decimals as he needed.

Fig. 6—Don't express data with false accuracy

1 and 2). The manufacturer is continually trying to put out a standardized product. This is the average. Because of normal manufacturing variations the individual production units are not all alike. This variation is the standard deviation. With good control, all the production units fall within a narrow range of manufacturing tolerances. This normal range is predictable and is usually taken as 2 or 3σ. Thus, Fig. 4 presents a horizontal line at the average percentage composition of a commercial chemical. There are also two other horizontal lines representing normal limits. These are drawn at the average $\pm 3\sigma$. The abscissa is used to plot batch numbers in a batch process or time of sampling in a continuous process.

The points show the test results obtained during the course of manufacture. During normal manufacture, when the approved conditions are controlling the purity of the product, the frequency of the observed purities will be as indicated by the distribution plot on the right hand side of Fig. 4. It will be noted that this is our old friend, Fig. 2, turned on edge.

If something goes wrong in the manufacturing process, then the normal controlling conditions do not hold, the purity is no longer restrained to the distribution shown and points will begin to fall outside the tolerances. Fig. 4 shows sample 13 as the first to fall outside the expected limits. At this point the man responsible should immediately take action to determine what factor in manufacture is varying. When the cause is found and eliminated the purity should return to within its manufacturing tolerance. The use of control charts thus tends to reduce variability and keep quality at desired levels. Some points to consider are illustrated in Figs. 7 and 8.

The use of statistical methods is generally conceded to be economically worth-while. In the presentation of data a mass of numbers is reduced to two or three figures so that the significance of the mass of numbers is easily and quickly grasped. Knowing the reliability of data it is easy to recognize which numerical difference are truly significant and warrant investigation. The principles of quality control are so generally admitted to be of assistance in production that during the war about 25 universities offered intensive courses in statistical quality control.

RECOMMENDED BOOKS

1. American Society for Testing Materials, "Manual on Presentation of Data," 3rd Printing, Philadelphia (1941).
2. American Standards Association, "Guide for Quality Control and Control Chart Method of Analyzing Data," New York (1941).
3. Arkin, H. and Colton, R. R., "An Outline of Statistical Methods," Barnes and Noble (1938).
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7. Shewhart, W. A., "Economic Control of Quality of Manufactured Products," D. Van Nostrand (1931).
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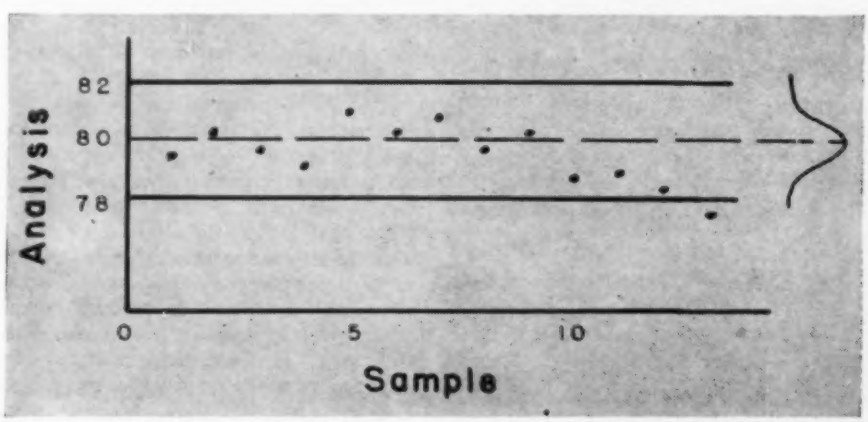
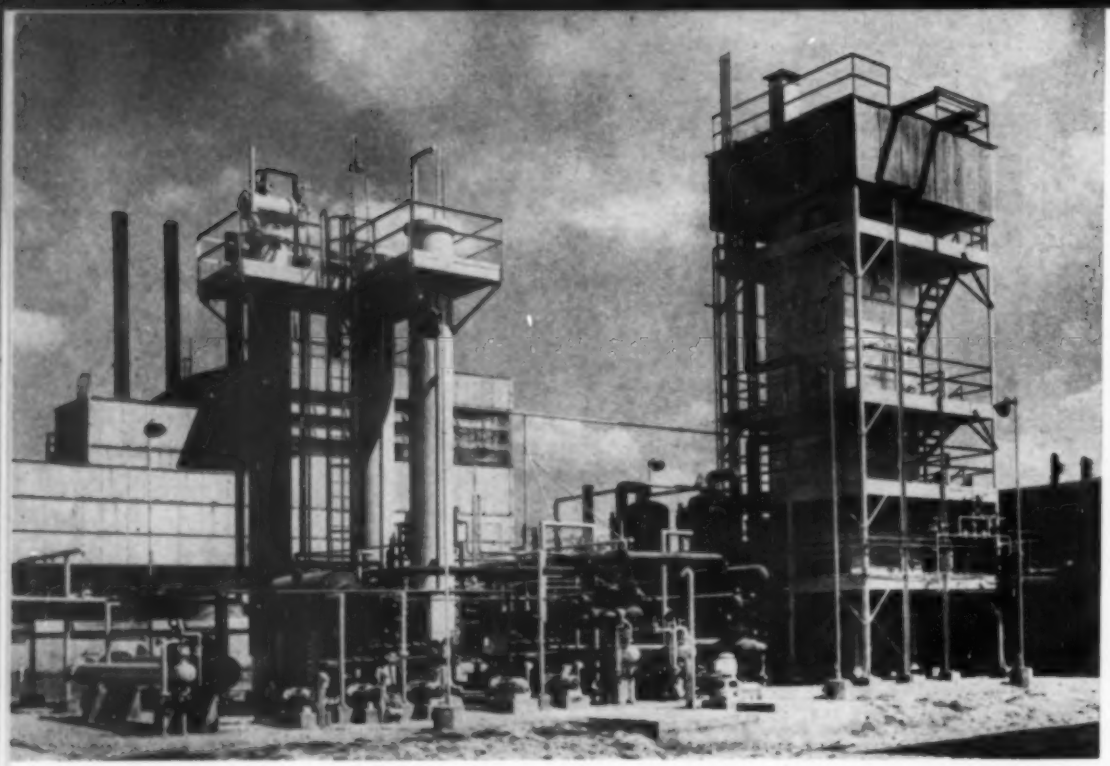
9. Simon, L. E., "An Engineer's Manual of Statistical Methods," John Wiley & Sons (1941).

Fig. 4—Quality control: Standard purity is 80, production tolerances are 78-82, the batch 13 result indicates an unusual condition





Process used in this plant combines several established processes into a unified, continuous, low-pressure method for producing hydrogen of high-purity

HYDROGEN

By the Steam-Hydrocarbon Process

The Steam-hydrocarbon process for the production of hydrogen has increased rapidly in importance in recent years, so that at present the hydrogen manufacturing capacity in the United States of plants employing this process is over four billion cubic feet of hydrogen per month. This hydrogen manufacturing capacity is exceeded only by the steam-watergas process, with an installed capacity of six billion cubic feet of hydrogen per month, the greater part being in older plants.—*Editors*

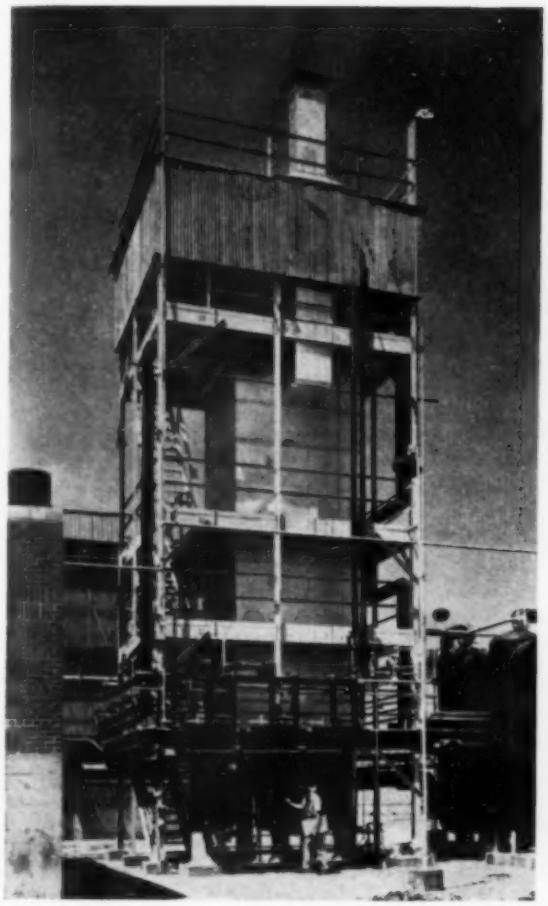
A NUMBER of different hydrocarbons, such as natural gas, refinery gas, propane, and butane, may be employed as process materials for the production of high-purity hydrogen by the steam-hydrocarbon (Hygirtol) process developed by the Girdler Corp. The first operation carried out in the plant is the removal of sulphur compounds if any are contained in the hydrocarbons. This may be accomplished by caustic scrubbing, or by passing the hydrocarbon at elevated temperature over a suitable catalyst such as bauxite or various metallic oxides to convert organic sulphur compounds to hydrogen sulphide, which may then be removed by caustic scrubbing, or by the Girbotol process employing amine solutions.

The desulphurized hydrocarbon is mixed with steam, and passed through a furnace where it is heated to about 1,500 deg. F. The hydrogen furnace contains externally heated alloy steel tubes filled with nickel catalyst which promotes the conversion of hydrocarbons and steam to carbon oxides and hydrogen.

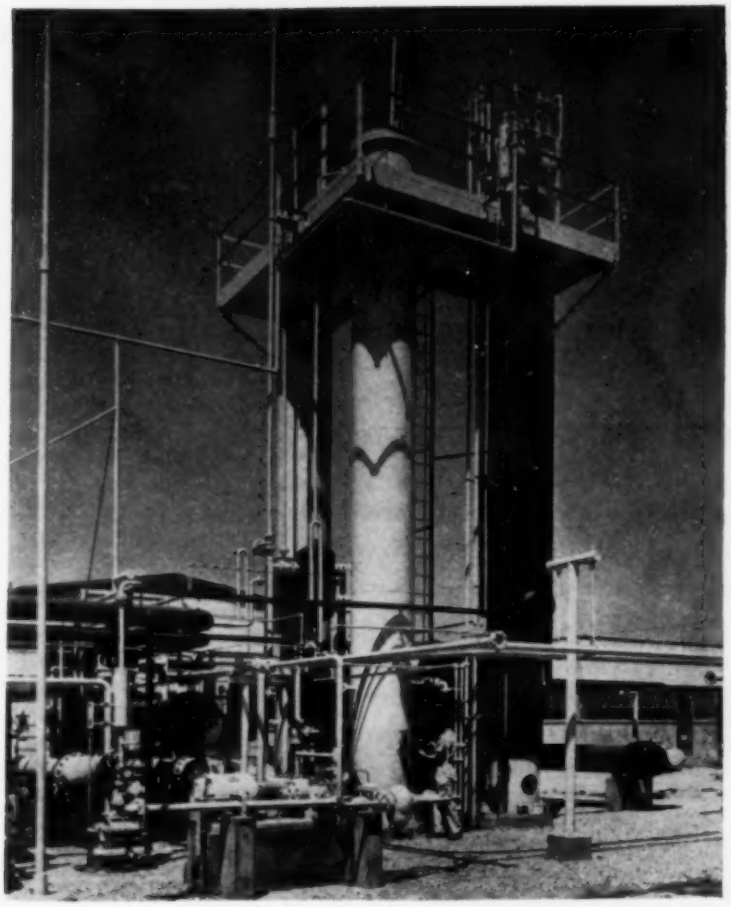
More steam is added to the gas stream at the furnace outlet to cool it to about 750 deg. F. before it enters a carbon monoxide converter containing an iron oxide catalyst which promotes the oxidation of carbon monoxide with steam to produce carbon dioxide and hydrogen. This oxidation is exothermic, 43 B.t.u. being liberated per cubic foot of carbon monoxide oxidized. The reaction is reversible, and under the operating conditions employed, slightly over 90 percent of the carbon monoxide is oxidized. The gas mixture from the converter passes through a heat exchanger and cooler and than flows through a carbon dioxide absorber, which may be either a packed or bubble tray tower.

The Girbotol process, employing aqueous amine solutions in a continuous regenerative process, is used for effecting carbon dioxide removal from the hydrogen in the Hygirtol plant. It is especially suitable for this purpose, since it is the only regenerative process available at present which provides substantially complete carbon dioxide removal from gas streams at low pressures. Because of the relatively large quantities of carbon dioxide to be removed, the use of non-regenerative absorbents such as sodium hydroxide is impractical.

In the carbon dioxide absorber, the gas flows up through the tower, while a stream of aqueous amine solution, such as a 15 percent aqueous solution of monoethanolamine, flows down the tower and removes the carbon dioxide from the gas stream. The amine solution is then reactivated by boiling and steam stripping in a second tower to remove the absorbed carbon dioxide from it.



Hydrogen furnace contains externally heated alloy steel tubes filled with nickel catalyst



Carbon dioxide (first and second stage) absorbers and reactivators are shown here. Note plant is out of doors

The hydrogen leaving the carbon dioxide absorber contains about 1 percent carbon monoxide, 0.1 percent carbon dioxide, and 0.1 percent methane.

Since carbon monoxide is an active poison for the nickel catalysts employed in many types of hydrogenation operations, the carbon monoxide content of the hydrogen must be reduced further before it is suitable for such use. This is accomplished by one or more stages of carbon monoxide oxidation followed by carbon dioxide removal. Intermediate heat exchange is employed to obtain the necessary operating temperatures in the carbon monoxide converters.

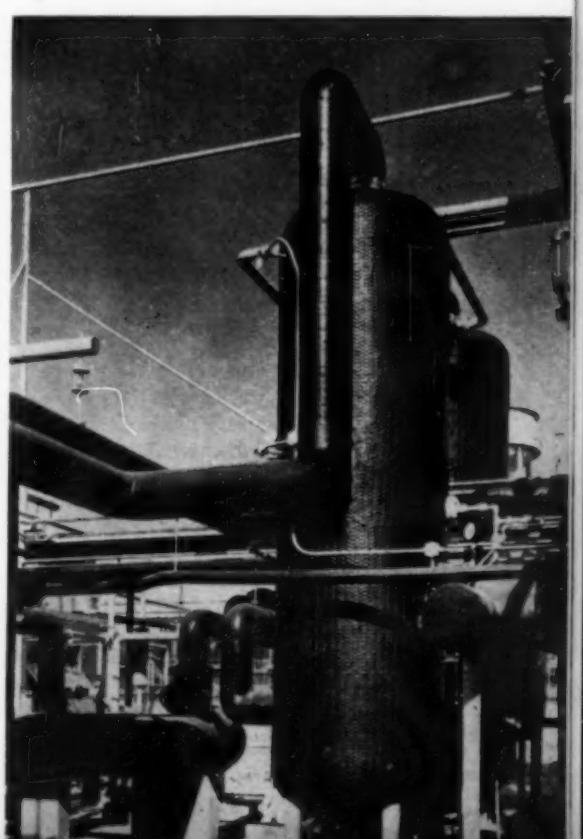
The same amine solution is passed in series through all the carbon dioxide absorbers in reverse order to the gas flow, since the quantities of carbon dioxide to be removed in the first absorbers it passes through are relatively small.

The hydrogen produced by the process outlined can be made more than 99.9 percent pure, and will contain less than 0.01 percent each of carbon monoxide and carbon dioxide, and less than 0.1 percent of residual hydrocarbon. Any nitrogen present in the process hydrocarbons will, of course, be present also in the purified hydrogen, but the nitrogen content of the hydrogen will be negligible if liquefied hydrocarbons such as propane or butane are used for producing the hydrogen or if the natural gas employed is nitrogen free.

The process as described above combines several established processes into a unified, continuous, low-pressure method for producing hydrogen of high purity. The production of hydrogen from hydrocarbons and steam was carried out commercially by Standard Oil Co. of New Jersey as early as 1930, although the hydrogen produced in their furnaces ordinarily contained about 1.0 to 1.5 percent methane. Hercules Powder Co. later developed a slightly different furnace design which made possible the production of hydrogen substantially free from hydrocarbons. This furnace design is employed in Hygirtol plants. By utilizing the Girbotol process for removing carbon dioxide from hydrogen during the various purification steps, hydrogen production can be carried out at low pressures, so that the Hygirtol plants operate at pressures only slightly above atmospheric. These plants were the first to produce hydrogen commercially from liquid propane, and were also the first commercial plants to produce high-purity hydrogen by the steam-hydrocarbon process.

For a pictured and digrammatic flowsheet of this process, refer to pages 162-165.

Carbon monoxide converters. Photographs from a typical Hygirtol plant



Developments on the Nuclear Front

EDITORIAL STAFF SUMMARY

With the McMahon Bill now reported to the Senate and the Acheson Committee Report on International Control of Atomic Energy attracting nationwide interest and comment, news also comes of the plan of Manhattan Engineer District to proceed immediately with the development of a pilot plant for atomic energy production at Oak Ridge, Tenn. Several papers were presented on various phases of nuclear energy and the atomic bomb at the Midwest Power Conference, held in Chicago in April. One of these papers is briefed herewith.—*Editors*

Electromagnetic Process

Facts not previously mentioned in published literature concerning the electromagnetic process used for the concentration of U-235 at Oak Ridge were brought out pertinently in a paper presented before the Midwest Power Conference in Chicago on April 5 by R. R. Wisner, assistant chief electrical engineer of Stone & Webster Engineering Corp., Boston, Mass. Although the paper dealt primarily with the electrical phases of this process, much of it was of chemical engineering interest. Mr. Wisner pointed out, as has previously been known, that the process is basically a modification of the mass spectrometer in which a suitable compound of uranium is first vaporized, then ionized by passing through an electric arc, after which the electrified atoms are given a forward acceleration by passing through electric fields having an increase in potential. The electrified and accelerated atoms move at high speed in a strong magnetic field which causes them to travel in a circular path, the diameter of the path being a function of the mass of the atoms. Thus the lighter U-235 atoms travel on a smaller diameter than the heavier U-238 atoms. At the proper point in the circular path separate containers are placed to receive the U-235 and U-238 atoms, respectively.

An idea of the magnitude of this development may be gained from the fact that work supervised or done by Stone & Webster's forces had a value of $427 million, including purchase of equipment for the plant and construction of most of the city of Oak Ridge. The electromagnetic plant contains about 175 buildings and a total floor working area of about 4,500,000 sq.ft. The urgency was so great that small scale laboratory developments were expanded directly into a gigantic production unit which was the first one to produce considerable quantities of usable products and for nearly a year was the only plant in production.

One of the most impressive features of the plant is the tremendous size of the electromagnets. These structures are 250 ft. long and contain thousands of tons of high permeability steel. Prior to their construction the largest magnet was probably that of the 184-in. cyclotron at Berkeley. The magnets used in the Y-12 plant are nearly 100 times as large.

Details of the construction cannot be given but it is interesting to point out that the magnets have many parallel circuits, that there is about 40 tons of insulation between the conductors and ground in one magnet, and that there is a large amount of heat generated which is carried away by transformer oil through heat exchangers. It is necessary that all types of insulation be thoroughly dry and that the oil piping should be maintained scrupulously clean and dry. Excitation of the magnets is accomplished by motor generator sets from which 100 percent service continuity and 100 percent annual load factor (without standby or reserves) are demanded.

In the air gap of the magnet is an evacuated operating chamber which the plant personnel call a "bin." The beams of the electrified uranium atoms which are curved by the action of the strong magnetic field must operate in an extremely high vacuum of the order of 25,000,000 times less than that considered standard in power plant condenser practice. To produce such a vacuum enormous pumps of the diffusion type were designed and built, working in series with standard mechanical constant displacement vacuum pumps. Were it not for this high vacuum the electrified uranium atoms would collide with atoms of oxygen, nitrogen and other gaseous elements, and in so doing might lose their electrical charges and no longer be under the proper control for the desired collections in the receiving pockets. The fabrication and installation of this vacuum equipment and piping required utmost care and skill, and involved tremendous amounts of field welding. The testing for and location of leaks was enormously facilitated by the so-called leak detector which has been described elsewhere.

An interesting aspect of the magnets is their enormous strength, so great that when a 20-penny nail is held in the hand, strong effort is necessary to prevent the wrist from being twisted. The pull on the nails in the heels of a pair of shoes is strong enough to make walking difficult at some points. Owing to such effects, all movable equipment and structures used within the range of the magnetic field had to be built of non-ferrous metals or of non-magnetic steels.

Some of the most important developments, but likewise the most secret, lie in the contributions to the process made by the electronic experts. To provide the required power supply, and to control it, many thousands of standard items (particularly electronic) were used in very ingenious circuit arrangements.

On some of the high voltage circuits cooling water having an extremely high resistance value is used to secure adequate insulation to ground. For this purpose a high resistance water cooling system was developed, using continuously deaerated, deionized water which allows the use of common materials for the water piping circuits.

CHEMICAL PROBLEMS

The problems encountered were not all electrical and mechanical, by any means, but were spread pretty well throughout all phases of engineering, physics and chemistry. Concerning chemistry, for example: During the operating period not all of the feed material is separated into its two component isotopes. A considerable portion of it goes astray and has to be recovered from the interior walls of the containing vessels and from parts of the operating equipment. Practically all uranium compounds have a high capacity for absorbing water. The metal also has a tendency to revert to the oxide. Another complication was introduced by the fact that the energy of the ionized particles is so great that those which go astray and impinge on various parts of the equipment combine chemically or physically with the metals forming those parts. The result is that a large operating area must be provided for washing and cleaning operations, where all parts of the apparatus can be cleaned with steam or acid. The product is an acid solution of uranium compounds containing large quantities of iron, nickel, copper and a number of other metallic elements. All of these must be separated from the uranium before it can be recycled in the process, or before it can be passed on to final concentration. Also, the uranium must be converted to the chemical compound which is more suitable for feed to the process and this compound must be of the highest purity, as well as completely dry and very finely pulverized. One important task was the design of an enormous chemical plant in which these reclaiming operations are conducted.

One of the interesting things about the chemical operations is the precautions taken to salvage every possible grain of uranium whose U-235 content has been enriched. One such precaution is the recovering of splashings from uniforms of the operators

in the chemical area. For this purpose uniforms are washed every day in small laundries in individual buildings. The wash water is saved and treated for the recovery of its uranium content. When the uniforms are worn out (and shoes as well) they are collected and sent to an incinerator building where they are burned and the ashes digested in acid and treated for uranium recovery.

In the separation apparatus a large number of carbon parts is provided to protect the metal structures from beam impingement. These become impregnated with uranium atoms and some of the carbon parts have a life of only one run. Others may be used for several runs, but then they are collected and sent to the incinerator building to be burned in an atmosphere of oxygen. The resulting small quantity of ash is treated for uranium recovery. Similarly, whenever a metal part is replaced the old part is sent to a salvage room, dissolved in acid, then treated for uranium recovery. Several large buildings are provided exclusively for treating salvage solutions. Another salvage operation which may seem far fetched is the treatment of the ventilating air from the chemical areas for uranium bearing entrained dust which might otherwise escape to the outside atmosphere.

In concluding his talk the author offered the opinion that the electromagnetic process should have almost unlimited scope in the development of atomic power and that the method would be most versatile in the commercial separation of the isotopes of many elements.

Atomic Power Plant

ON APRIL 12, Major General L. R. Groves, head of the Manhattan Engineer District, announced that steps were to be undertaken immediately to develop atomic energy for the generation of peacetime electricity. Monsanto Chemical Co. has over-all authority and responsibility for the design and construction as well as the operation of an experimental atomic energy power plant at Oak Ridge, although other industrial organizations have been asked to participate in the development as consultants and in the furnishing of technical men. Scientists connected with the Manhattan Project, including the Metallurgical Laboratory, will assist throughout the work, as well as specialists of the Army, the Army Air Forces and the Navy. The initial atomic energy demonstration plant is to be based on fundamental research carried out largely at the Metallurgical Laboratory. Dr. Farrington Daniels, project director of the Metallurgical Laboratory, is the author of the basic concepts which will make the plant possible.

Monsanto's vice president and technical director, Dr. Charles Allen Thomas, will be in charge of the project which will involve the design, construction and operation of a chain reaction pile, together with auxiliary equipment. Although the plant will produce some electricity, it probably will not be economic for such production, nor is that intended. Study has already reached a point where draftsmen are ready to translate technical data into engineering blueprints and actual construction is expected to get under way this year with an initial expenditure tentatively placed at $2,500,000.

The present problem is to reduce to practice some of the many ideas for power piles developed as an outgrowth of the atomic bomb program and to supply evidence that may eventually be of value in clarifying any international patent situations that arise.

Unlike the Chicago, Clinton and Hanford piles which were developed to produce the explosive plutonium, the new installation will have as its primary purpose the generation of energy and the conversion of that energy to electricity. The change of purpose introduces many new problems which may require years for their solution, and it is not unlikely that new and radical engineering principles will be considered in the conversion of atomic energy to mechanical and electrical energy.

The power unit is to be known as the Daniels pile in honor of Farrington Daniels. Technical phases of the power project will be in charge of Dr. C. Rogers McCullough, and a laboratory staff, while administrative phases will be under Dr. M. D. Whitaker, laboratory director of Monsanto-Clinton Laboratories.

International Control

PRESS TIME for our April issue did not allow sufficient opportunity for digesting all the more important highlights of the State Department's Acheson report on International Control of Atomic Energy. This report which was in the main the work of David E. Lilienthal, Chester I. Barnard, J. Robert Oppenheimer, Charles Allen Thomas and Harry A. Winne, was issued in early April in printed form to stimulate discussion on a nation-wide basis of the admittedly tentative but carefully thought-out proposals that were made.

In briefest summary, the plan is to place the production of all kinds of fissionable materials, including denatured materials for power production, entirely under the control of an international agency with powers of inspection and supervision. Fundamentally, the aim is to place all operations which may be considered "dangerous" in the hands of this body, allowing non-dangerous activities in connection with medical uses for radioactive materials, and the development of industrial uses such as power production, to be licensed to nations or to private users.

The plan, of course, requires the disclosure of information, but permits this disclosure by progressive stages depending upon the speed of acceptance of the plan by the nations making up the international authority.

The Report Committee arrived at the unanimous conclusion that there is no prospect of security against atomic warfare in a system of international agreement to outlaw such weapons that is controlled only by reliance on inspection and similar police-like methods. So long as intrinsically dangerous activities may be carried on by individual nations, rivalries are inevitable and fears will be engendered that will place so great a pressure upon a system of international enforcement by police methods that no degree of ingenuity or technical competence could possibly hope to cope with them. Every phase in the activities leading from raw materials to weapons, the Committee concluded, needs some sort of control, which must be exercised on all the various paths that may lead from the one to the other. A fundamental objection to an agency charged solely with inspection is that it will inevitably be slow to take into account changes in the science and technology of the field. Instead, in a field so new and so subject to technical variations and changes, the controlling agency must perforce be at least as inventive and as well informed as any agency that might attempt to evade control.

The only scientific evidence that is worthy of regard, according to the Committee, makes it clear that uranium, and uranium alone, is indispensible in the production of fissionable materials on a scale large enough to make explosives or power. It is, in fact, stated that uranium is the only natural substance that can maintain a chain reaction and that thorium in large quantities can react chain-wise only in the presence of a fairly substantial amount of uranium. The conditions for reactions of light nuclei (solar and star reactions), it is claimed, cannot now and may never be capable of duplication on the earth. It is not anticipated that the situation outlined will be invalidated by further scientific discovery.

Therefore, absolute control of uranium would mean adequate safeguard of raw materials, although the possibility of a substantial leakage of uranium would also make it desirable to control thorium. The more likely areas for these materials would probably have to be surveyed, so that all known deposits of uranium ores could be placed under the legal ownership of an international agency manned by and representing all nations. Then the mere fact of these ores being mined or possessed by other organizations would become illegal.

The report points out that the amounts of fissionable materials which are small in relation to those needed to make a weapon are not regarded as dangerous. Further-

(*Continued on page 138*)

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AUTOXIDATION PROCESS

For Sulphuric Acid and Sulphate Production

For at least 50 years consideration has been given to the possibility of producing sulphuric acid at relatively low concentration by direct oxidation of sulphur dioxide with air in the presence of certain metal ions which serve as catalysts. For one reason or another the process has heretofore not received acceptance, but it is now being demonstrated on a commercial scale and the author presents cogent reasons why it should be valuable under proper circumstances. Especially is the method indicated where byproduct sulphur dioxide that may be weak, variable and dirty is available. Long freight hauls for acid or iron salts (for sanitation) may also make local production by this means desirable.—*Editors*

PRODUCTION of sulphuric acid by present standard methods leaves little to be desired in the usual cases, especially when elemental sulphur, sulphide ores and some byproduct gases are used. This statement is correct, in particular, when relatively large scale and relatively strong gases can be used. However, for more than 50 years attention has been directed toward the development of a simple, practical method for converting sulphur dioxide to acid or other sulphate which can be used on either a large or small scale and can make use of wet, dirty or fluctuating gases of varying SO_2-SO_3 ratios. Such a process, using "autoxidation" by means of a liquid catalyst for the economic fixtion of SO_2, has been applied successfully on a small commercial scale and is discussed in this article. The method is suitable for the production of cheap acid or sulphates on either a large or a small scale where transportation charges on commercial acid constitute a major cost item.

A general process for converting SO_2 must be applicable to a wide range of conditions under which the gas may be produced. As witness of this range note the following typical gas sources and SO_2 concentrations: crude sulphur, 3 to 16 percent; sulphide ores, 2 to 11; copper converters, 2 to 12; copper and lead smelting furnaces, 0.5 to 1; boilers stacks, 0.1 to 0.5; oil refining, 1 to 12; and byproducts ferrous sulphate, 4 to 12 percent. Sulphur is wasted in various chemical and metallurgical operations to such an extent that utilization should be considered, not only on account of the increasing importance of air sanitation, but also to avoid economic waste.

Various objectives may be listed in the development of a general, simplified method of SO_2 fixation. These include production of cheap, dilute acid for industrial uses such as pickling steel or leaching copper or other ores; production of concentrated acid where economic conditions warrant; abatement of atmospheric pollution; production of cheap sulphate salts such as ferric sulphate for sanitation use; and, in general, the utilization of any industrial gas, regardless of dust, moisture or the presence of SO_3, provided it contains at least 0.5 percent SO_2.

In considering the various SO_2 sources, certain characteristics of the gas composition must be considered in applying standard processes. Dust of about 10 microns maximum size will be found in gases resulting from calcining, burning or smelting operations if standard dust collection rather than wet scrubbing is employed. Constituents of the dust may or may not be soluble in the resulting acid, which may determine the method of dust separation used. Again, the presence of moisture in the gas may result in H_2SO_4 fume if SO_3 is present and thus offer a problem. Finally, some sources give fluctuating gas strength and volume, for example, copper converters, while others such as boiler furnaces and lead and copper smelting operations give uniformly low but appreciable SO_3 contents.

An effective method of producing acid or a sulphate salt from gases of such characteristics will, as a first requisite, need to be adaptable to wet, dirty, dilute, fluctuating gas. Acid or a sulphate salt if initially produced as a dilute solution may be concentrated in standard equipment when required. Simple and positive steps, together with relatively low costs of equipment and operation are obviously essential.

AUTOXIDATION METHOD

That sulphur dioxide may be oxidized to sulphate in presence of certain metal cations has been known for over 50 years.[1] Comprehensive investigations by the U. S. Bureau of Mines[2] showed the feasibility of using sulphur dioxide-air mixtures (1) to oxidize ferrous to ferric sulphate, and subsequently, (2) to produce free sulphuric acid up to 5 percent strength, as leaching solvent for copper ores. The reactions are,

$$2FeSO_4 + O_2 + SO_2 = Fe_2(SO_4)_3 \quad (1)$$

$$2SO_2 + O_2 + 2H_2O = 2H_2SO_4 \quad (2)$$

Laboratory studies were followed by two pilot plant installations[3] in which gas from pyrite roasting was blown through closely woven woolen or mohair porous fabric into a tank of iron sulphate solution. Use of various metallic ions in catalyzing SO_2 oxidation was investigated by Johnstone[4] as a means of scrubbing boiler stack gases to remove SO_2. Copson and Payne[5] made a thorough study of the same basic method, employing various concentrations of manganese sulphate, with a porous bottom cell, to produce acid up to 40 percent H_2SO_4. Packed towers were also tried, with a greatly decreasing volume capacity for acid production as the size of the tower was increased. Mining companies in the Southwest conducted investigations, including commercial scale operations, in utilizing roaster gas to produce ferric sulphate-sulphuric acid acid mixtures for copper ore leaching.[6]

These various investigations, which covered a wide range of objectives and gas conditions and engaged competent staffs of several organizations over a period of more than 20 years (at a total cost probably equalling several hundred thousand dollars), were in general agreement on the following fundamental points:[6]

1. Sulphur dioxide may be oxidized effectively to sulphate by a large excess of air in the presence of dissolved iron or manganese. The oxygen absorption efficiency is generally not over about 25 percent.

2. Ferrous sulphate is simultaneously oxidized with sulphur dioxide, to form ferric sulphate, under conditions as in (1) above, provided a critical rate of SO_2 absorption is not exceeded. This oxidation is inhibited by free acid, according to acid strength.

3. Sulphuric acid may be produced as a result of SO_2 oxidation in the presence of ferric or manganese sulphate catalyst.

4. The rate of SO_2 conversion is limited by the oxygen absorption coefficient of the solution. This imposes a definite limitation which determines the solution reaction rate and, therefore, fixes the volume of solution required in the circuit. The conversion rate expected for commercial operation is 5-20 grams of H_2SO_4 per liter per hour.

5. Manganese ion is more effective than ferric ion as a catalyst. However, manganese is also more susceptible to poisoning by certain impurities than iron.

6. Rate of sulphate formation in solution decreases as the acid concentration increases, at a given efficiency of SO_2 absorption. This implies loss of SO_2 if a high conversion rate and high acid strengths are effected simultaneously, unless supplementary means of absorbing vented SO_2 are adopted. Maximum acid formation rates in solution appear to be about 2 percent H_2SO_4 per hour for iron catalyst, and 4 percent per hour for manganese catalyst, which determines the minimum volume of solution required in the reaction cells under ideal conditions.

7. To obtain a maximum rate of acid formation it is necessary to maintain the solution uniformly saturated with oxygen derived from the air during contact with SO_2. Ordinarily, a ratio of oxygen to SO_2 of at least 4:1 by volume is necessary for the gases contacting the solution.

8. Within reasonable limits, the SO_2 conversion rate is enhanced as the solution temperature is increased. The reaction is strongly exothermic, and as evaporation and air introduction exert a cooling effect, a satisfactory operating temperature balance is maintained at about 120 to 160 deg. F. under normal conditions.

9. In producing acid with a metal salt catalyst, ferrous sulphate in large excess has a distinct poisoning effect on the reaction.

EARLY ATTEMPTS

The early Bureau of Mines work, as well as subsequent investigations, tested the impeller-type gas absorber as a means of introducing SO_2 gas and air into solution, but this was discarded years ago on account of high power consumption, in favor of porous bottom cells, which were used in most of the early investigations. Under laboratory conditions this latter method worked well, readily forming gas-air bubbles of less than 1 mm. diameter. Under pilot plant conditions dust tended to clog rigid porous media while fluctuations caused instability and reversed the oxidation when the gas-air ratio exceeded the critical value when an iron sulphate catalyst was used. The greatest difficulty however was the mechanical one of compressing dirty, wet gas containing SO_2 mist to high enough pressure for forcing through a porous medium. Despite the mechanical problem the method worked successfully in two pilot plant installations[a] and showed no catalyst poisoning.

Gas scrubber type conversion cells were also tried, with the advantage of low gas pressure drop. It was of course necessary to elevate large quantities of solution, the quantity necessary being fixed by the desired rate of SO_2 absorption. Inexpensive fans could be used, but poor absorption was secured with any reasonable absorption volume and rate of solution circulation. Cells of this type using air lift cascades have operated satisfactorily, aside from a rather low conversion rate (or appreciable loss of SO_2) in producing dilute mixtures of acid and sulphate (e.g. 2.5 gram H_2SO_4 and 1.8 gram ferric sulphate per liter).

Packed towers have also been used. Results of tests on a lead laboratory column 8 ft. high and 3 in. in diameter appear in Table I. Tests *A* are the average of four single-stage tests while tests *B* are the average of two tests, each run in four stages to simulate four towers in series. In all tests ferrous sulphate at 2 grams Fe per liter was used as the catalyst. The effluent solution showed an average of 80 percent oxidation of iron so that it appears that the tower system is limited to situations where a high degree of iron oxidation is not needed.

AIR DIFFUSER CELL

In 1938 the City of Phoenix, Ariz., embarked on an experimental program to produce cheap iron sulphate salts for sewage treatment. Both ferric and ferrous sulphates were desired. None of the above described types of apparatus could meet the requirements for efficiency of SO_2 conversion needed on a commercial scale when using sulphur burner gas and oxidizing iron in strengths of several percent Fe, without forming acid simultaneously. The problem was solved by developing the conversion apparatus shown in Figs. 1 and 2. The sulphur dioxide gas is introduced into the solution tank by perforated lead pipe distributors having a submergence fixed by the pressure characteristics of the gas blower employed. Submergence as low as 6 in. was found to give more complete gas absorption than by using cascading solution streams induced by air lift action.

In this apparatus uniform, fine dissemination of air is produced by its separate introduction through cylindrical alundum tubes. "Aloxite" brand tubes of No. 5 permeability rating were found suitable, giving bubbles of approximately 1 mm. diameter. A plant, utilizing waste iron scrap, having a capacity of 1 ton ferric sulphate per 24 hours, anhydrous salt basis, or approximately 1 ton H_2SO_4 as dilute acid up to 15 percent strength, was constructed following the pilot scale investigations. It has been in commercial operation for the past 7 years with a record of no substantial alterations or repairs. Cleaning of aerator tubes is occasionally accomplished by allowing acid solution to backflush the tubes. During this operating period the entire set of 24 porous tubes has been removed only once for cleaning by pickling in muriatic acid. Many of the original tubes are still in active service. Data over this period have been recorded in a previous publication.[7] Application to metallurgical practice, employing gas from roasting operations to produce dilute sulphuric acid (and also ferric sulphate where applicable) has also been described.[8] This SO_2 fixation method, and the recently developed apparatus, have been incorporated into a process for commercial production of acid or ferric sulphate, and in some cases ferrous sulphate.[9]

Recent tests at the Phoenix plant have shown the feasibility of oxidizing iron in sclutions containing up to 70 grams Fe per liter with only slight decrease in plant conversion capacity.

Iron is added to the system by treating a portion of the oxidized cell solution with iron scrap from a city dump. If manganese is desired, the ore may be leached with SO_2 in dilute acid solution.

This "air diffusion" cell for SO_2 conversion was found to have the following advantages: (1) Positive, uniform and fine dissemination of air for oxidation. (2) Positive, non-clogging means of SO_2 introduction and dispersion at low pressures (1 to 2 lb.). (3) High efficiency of SO_2 absorption and conversion. (4) Strong oxidizing effect and chemical stability. (5) Low power consump-

Table I—Acid Production in a Packed Tower

	Percent SO_2		Acid Production	
	Influent	Effluent	G. H_2SO_4 per L., Effluent	Lb. H_2SO_4 per Hr. per Cu. Ft. Tower
A	11.8	0.65	151.6	0.25
B	10.0	0.015	282	0.054

[a] The writer is in general agreement with results of other investigators in this field, with the possible exception of the poisoning effects on manganese catalyst mentioned in earlier work. In laboratory and pilot plant tests reaction cells of wood with lead and rubber fittings, such as distributor pipes and connections, were used repeatedly, with excellent results in operating with manganese catalyst. After a shutdown and cooling-off period, however, difficulty is sometimes experienced in getting the reaction started again, particularly in presence of fairly strong acid, or when certain coalescence inhibitors such as glue or pine oil are used to maintain fineness of air bubbles. There is evidence that, with either manganese or iron catalyst, some intermediate reaction product may exist which promotes the reaction. In any event, when the system has been established in properly balanced operation, it may be relied on to continue to function within the limits as herein set forth. No difficulty has been experienced in using ordinary water supply or lead fittings with manganese catalyst in tests made in Arizona, Pennsylvania and California.

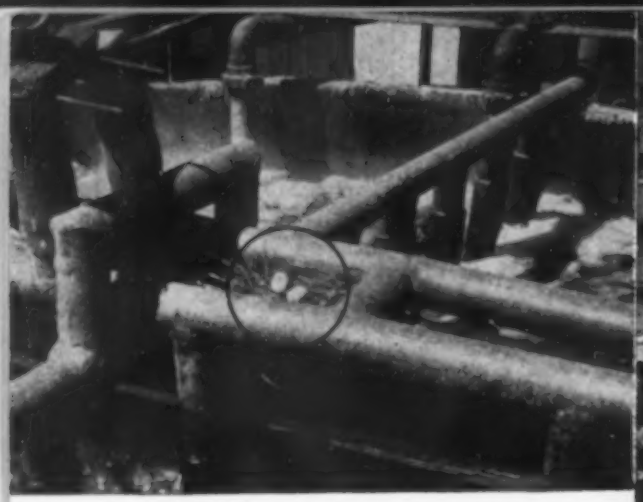

Fig. 1, Above—Autoxidation cell at Phoenix sewage treatment plant where purchased sulphur and scrap iron produce ferric sulphate; note bird's nest and eggs between air headers, indicating lack of unconverted gas

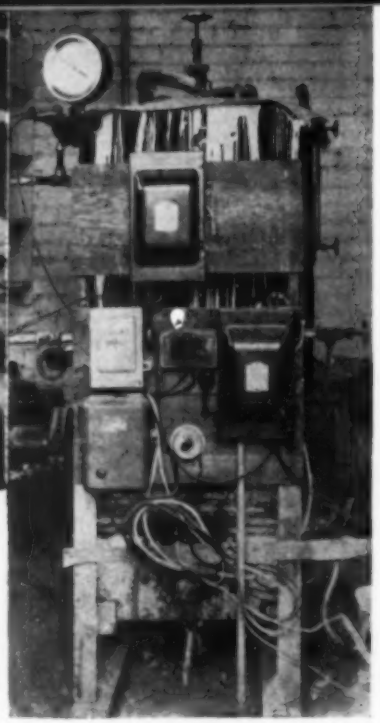

Fig. 3, Right—Freeport semi-automatic pressure sulphur burner at Phoenix plant

tion. (6) Application to any strength SO_2, above 1 percent. (7) Freedom from mechanical difficulties and chemical corrosion.

As a logical method of producing acid up to 15 percent, this plant was utilized for several test runs, employing both iron and manganese catalyst in different runs. All tests were on batch basis in a round wood stave cell of 9 ft. 6 in. inside diameter and 4 ft. 6 in. solution height. The aerator consisted of 24 tubes of Aloxite, 24 in. long x 4¼ in. O.D., set on the tank bottom and connected by lead tees. The SO_2 distributor was formed of three 2-in. lead pipes perforated with $\frac{1}{16}$ in. holes ½ in. apart, set with a submergence of 1½-3 ft. The air flow rate for the porous tubes was 125-175 c.f.m., and to the sulphur burner, 130 c.f.m. The volume of solution in the cell was 2,270 gal.

Table II—Plant Scale Acid Production In an Air Diffuser Cell

Catalyst		SO_2, Percent		Acid G./L.	
Type	G./L.	Influent	Effluent*	Per Hour	Final Conc.
Iron.....	2	3.94	0.045	4.07	110
Iron.....	13	3.77	0.052	5.15	143
Iron.....	36	2.97	0.013	3.79	93
Manganese.	1	3.81	0.067	4.89	165

* Effluent gas was diluted about one-half, due to mixing with the aeration air.

Table III—Laboratory Tests of Air Diffuser Cell For Maximum Acid Strength

Catalyst,	SO_2, Percent		Acid, G./L.	
Mn, G./L.	Influent	Effluent*	Per Hour	Final Conc.
0.5	Variable	0–0.56	5.63	234
1.0	5.35	0.03–1.0	5.5	332

* See Table II

Table IV—Ferric Sulphate From Sulphur Dioxide, Air and Scrap Iron

	Oxidized Solution Data		
	Ferric Iron, G./L.	Percent Oxidation of Iron	H_2SO_4 Conc., G./L.
A	30.4	97.1	2.53
B	26.6	95.5	2.20
C	28.3	98.6	0.90

The sulphur burner (Fig. 3) is of the semi-automatic pan-pressure type, developed by the Freeport Sulphur Co.[10] The burning pan area is 3.4 sq. ft. Air from the sewage plant power house is supplied at 6 lb. pressure to the SO_2 plant, and fed separately by valve control to the sulphur burner which operates at 0.8-1.5 lb. pressure, and to the aerator system operating at 3 to 4 lb. pressure. Sulphur dioxide gas at about 4 percent is added under pressure directly to the cell gas distributors.

Typical plant batch runs on acid production are summarized in Table II for both iron and manganese catalyst.

The low sulphur dioxide content of the influent gas, and the low rate of acid formation, were due to the design characteristics and small size of the sulphur burner. This prevented the conversion cell from operating at its normal capacity.

Pilot plant and laboratory tests, conducted in Pennsylvania with a similar type conversion cell, using 5 grams Fe per liter as catalyst, showed conversion rates of 10-11 grams acid per liter per hour, with 6 percent SO_2 supplied to the cell, and a final acid strength of 100 grams per liter. The SO_2 conversion efficiency was 93 to 99 percent.

Table III shows the high acid results obtained with an air diffuser cell on a 10-liter laboratory scale, using manganese catalyst. No attempts were made to produce such strong acid in plant scale tests, owing to lack of a stack for venting the effluent gas. The problem indicated in these tests was disposition of effluent gas containing appreciable SO_2.

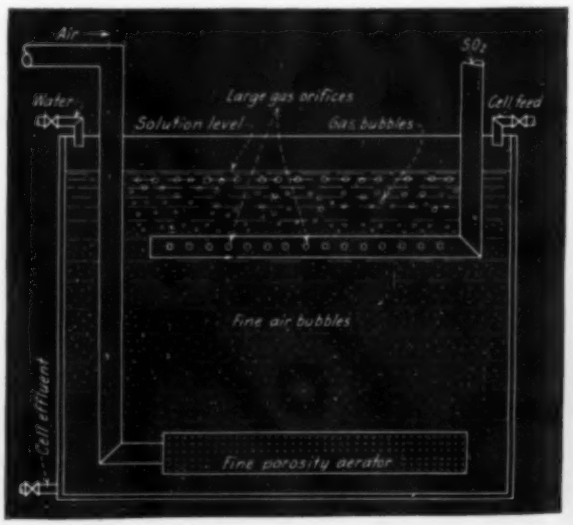

Fig. 2—Cross section of type of air diffuser cell used at Phoenix to produce ferric sulphate or sulphuric acid from ferrous sulphate, sulphur dioxide and air

Appreciable SO_2 is evident in the cell effluent gas at acid strengths over 15 percent. This is not vital if the SO_2 gas is normally wasted, as in smelter stacks. Otherwise, some form of countercurrent gas-cell solution flow, or an effluent gas absorbant such as activated carbon, would be required for acid production in the ranges of 20-30 percent.

The Phoenix plant at the sewage treatment works is currently used to produce ferrous sulphate for odor control. Ferric sulphate or sulphuric acid may be produced with no alteration of plant conditions. Regular practice here involves oxidation of 25-30 grams Fe per liter with no substantial free acid produced. Makeup iron, as noted, is obtained from the city dump. No deleterious effect has been found on the surrounding vegetation, notwithstanding the lack of a stack for exhaust gases (nor were there gases enough to prevent the egg laying shown in Fig. 1).

Table IV gives a summary of results obtained in ferric sulphate production,[7] using the air diffuser cell at the Phoenix sewage treatment plant. Tests *A* give the average of five pilot plant tests, *B* the average of 5½ yr. of commercial operation, and *C* a single plant run.

In this ferric sulphate process, action is stopped in the cell at completion of iron oxidation and before appreciable free acid forms. In order to maintain the cycle the correct amount of ferric sulphate from the cell is added to the scrap iron tank to effect dissolution of metallic iron. Ferrous iron and makeup water are then returned to the oxidation cell.

Potentialities of lowered cost for ferric sulphate, as compared to ferric chloride, are apparent from a consideration of the relative

costs of the sulphur and the chlorine (based on present delivered costs at Phoenix) that combine with 1 lb. of metallic iron. These amount to $0.00995 for sulphur in ferric sulphate and $0.0563 for chlorine in ferric chloride. Production of low cost iron sulphate has been demonstrated successfully at Phoenix, while still lower costs are anticipated in situations where waste SO_2 can be utilized.

ENGINEERING DEVELOPMENT

It is believed that this process background of more than 50 years, with over 20 years intensive work, has been adequate to establish the basic principles involved, and to delimit the required operating conditions. Unless some innovation is developed that will greatly increase the oxygen absorption coefficient of the reacting solution, the characteristics described here may now be set up as a basis for engineering design.

In planning the mechanical equipment, attention first must be given to the type of gas to be handled. If this is of the large volume type with low SO_2 content (not over 1 percent), uniform flow, low temperature and low dust content, complete SO_2 removal is non-essential. Examples include boiler stack gases and dust-treated gases from lead and copper smelting furnaces.

Conversion of SO_2 here involves a modified gas scrubbing system that will not seriously disturb draft conditions in the flow of gas being vented to a high stack. The required solution volume to be established is readily determined from the rate of sulphate formation in the solution. If the gas contains insufficient oxygen to effect the reaction, air must be introduced into the solution. The engineering problem is that of contacting the reacting solution effectively with the large volumes of gas encountered. The economic problems are chiefly those of power for circulating solution, plant cost, and disposal of the reaction product (which may be either dilute sulphuric acid or other sulphate solution) as byproducts of an established plant. Concentration of either type solution to produce a standard commercial product is possible. The mechanical problem embraces the engineering features of a combined gas washer and SO_2 converter, which is the type considered applicable to gases containing not over 1 percent SO_2.

However, if the available gas is produced in relatively small volumes, with variable composition, a likely fluctuating flow, and SO_2 concentration above 1 percent, then high temperature is possible, together with appreciable SO_3, high moisture content, and dust from standard cleaning apparatus that is about 10 microns maximum size. In this case substantially complete SO_2 removal is generally required. Sulphur burner gas, although constant and clean, is included in this category owing to similar technical problems.

A standard type conversion plant that is applicable to any of the conditions just listed requires a versatile process to overcome wide variations in gas composition and simultaneously effect a practically complete removal of SO_2. Here, gas that may result from a calcining, roasting or other industrial operation such as copper converting, must be contacted with the solution so that acid of 20 percent H_2SO_4, or ferric sulphate solution of 7 percent Fe may be produced if desired. Furthermore, reasonably complete SO_2 absorption and inexpensive operation must be obtained. A plant of this type would have to supply a definite product for which a specific use exists. For such requirements the air diffuser cell has been shown to be the most feasible type.

COMMERCIAL PLANT

With the exception of small installations burning sulphur under pressure, it is expected that any dirty SO_2 gas typical of industrial operations may be utilized at any reasonable temperature, and with varying SO_2 content. A typical situation would be use of roaster gas to produce 10 percent acid for copper ore leaching. The iron sulphate catalyst is supplied by utilizing a portion of the ferrous sulphate solution resulting from precipitation of copper from sulphate solution by scrap iron. Figs. 4 and 5 show suggested arrangements, employing crude sulphur in a pressure burner, or using gas at atmospheric pressure from a roasting or calcining operation. In Fig. 5 a cooling system—either a spray or packed tower—cools the gas when required by contacting it with the solution to or from the cell system. This also eliminates dust from the gas which facilitates blower operation.

The cooled, wet, dust-free gas is then blown through the perforated lead distributors, which are submerged 1 to 3 ft., and into the cells at a pressure of not over 2 lb. This may be obtained by a single-stage rotary blower. If a positive pressure blower is used, the degree of submergence is determined by cost of power compared to the small additional absorption capacity attained by the greater submergence. In any case the blowers must be constructed to withstand action of sulphurous acid and sulphuric acid mist at elevated temperature. If the gas is initially cool enough to handle directly, and acid strength above 15 percent is not required, the towers might be omitted.

If a packed tower system of adequate capacity is employed and cell effluent is used to cool the gas, the acid strength may be raised according to the retention time of solution in the tower. Thus, by countercurrent action involving the air diffusion cell and a packed tower system, acid as high as 25 percent may be produced without wasting substantial amounts of SO_2, as the tower effluent gas may be passed through air diffuser cells to complete the SO_2 utilization. Also, as indicated by results in Table III, cell effluent gas from 25-30 percent acid solution could be passed through absorption towers countercurrent to the incoming solution, thus minimizing SO_2 losses in produc-

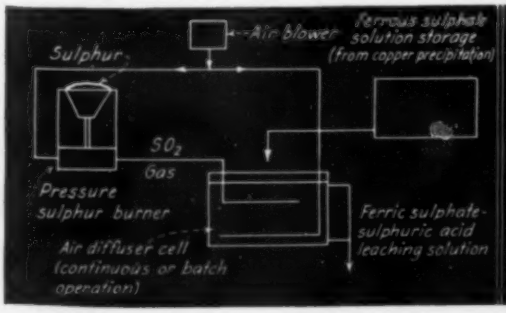

Fig. 4—Typical flowsheet of ferric sulphate-sulphuric acid plant using a pressure burner for crude sulphur

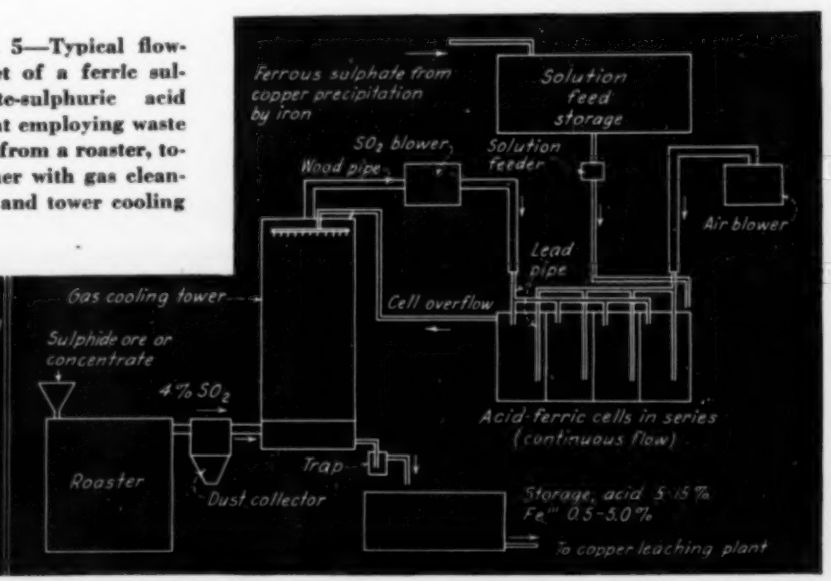

Fig. 5—Typical flowsheet of a ferric sulphate-sulphuric acid plant employing waste gas from a roaster, together with gas cleaning and tower cooling

ing 25-30 percent acid at commercial capacity figures.

The work of Copson and Payne[5] has indicated decreasing acid formation rate per unit of tower volume, as the size of tower and packing is increased. It appears at this writing, therefore, that a tower system should be designed primarily as a final gas scrubber, or as an initial gas cooler and H_2SO_4 mist filter. In the latter case the cell solution effluent may be boosted a few percent in acid strength, depending on the uniformity of gas and solution distribution in the tower and also on the degree of fineness of tower packing that is feasible to use. High SO_2 content would tend, by condensation to acid mist and collection in the tower, to result in a further increase in acid strength. By passing cool cell influent solution first through the gas cooler instead of directly to the cells, a greater temperature reduction may be obtained. It appears then that production of acid up to about 25 percent, or ferric sulphate solution up to 7 percent Fe is primarily a matter of engineering, involving known rates of solution conversion and proven process steps. The best general solution offered so far for a gas of more than 1 percent SO_2 is the combined cooling tower with SO_4 mist filter, and air diffuser cells, with a suitable gas blower between these units.

SOLUTION-GAS CONTACT

Since the present work here described is in agreement with modern sanitation practice regarding the effective use of calibrated porous aerator tubes for air dissemination, there is no further point of dispute as to the correct means of aerating large bodies of solution at considerable depths. The other question, that of dispersing dilute SO_2 gas into the solution, is believed solved through a suitably designed, corrosion resistant gas blower which introduces the gas uniformly and separately from the air through perforated lead pipes at a definite submergence. This method seems preferable to the use of mechanically driven impellers set at intervals in the solution body.

Although such impeller agitators have sometimes been used effectively on a small scale for simultaneous absorption of SO_2 and aeration of solution for sulphate production, for the reasons set forth they are not considered suitable in this process. Impeller agitators have, however, a logical field in other processes where solids in suspension or supersaturated solution would cause clogging of fine porous aerators.

Special cases of use of the autoxidation process might deal with calcining operations, such as decomposition of ferrous sulphate. These operations produce gas high in moisture, dust and SO_2. If the dust contains substances that are insoluble in the acid produced, or deleterious to subsequent operations, it should be removed by wet scrubbing in which case the scrubbing solution would be utilized in the cell system or discarded, according to expediency. Small amounts of iron oxide dust should be soluble in hot acid of 20 percent, so that such dust would not accumulate to any serious extent in a packed tower. Any SO_3 in any such gas would be converted to H_2SO_4 mist by the cooling and humidifying effect of the scrubbing, and would be combined with the scrubbing solution if sufficient filtering action were provided. As noted, this supplies means of increasing the dilute acid concentration if the cell effluent is used to scrub an incoming gas which contains both SO_2 and SO_3.

Various means of treating such products as waste pickle liquor from steel plants, to recover iron sulphate and effect calcination, have been enumerated by Hodge.[11] A means of acid production from SO_2-SO_3 mixtures, as presented in this paper, has been suggested by the writer[12] in a process proposed for treating pickle liquor.

OVER-ALL ACID COST

By the use of minimum catalyst concentration and the production of acid of 20 to 30 percent strength, concentration to 65 percent strength is considered commercially feasible, with various available acid concentrators. The cost of concentrating acid from 25 to 65 percent strength would be about \$4 per ton of H_2SO_4, including all direct and indirect charges.

Operating costs per ton H_2SO_4, starting with the SO_2 gas already produced, consist of power for blowing air and gas and pumping solution, amounting to not over 200 kw.-hr. (about \$1); labor and supervision to regulate solution and gas flow, amounting to not over \$2; and amortization and maintenance estimated at not more than \$2; per ton acid. For general estimating purposes, then, the total operating costs (less SO_2 cost) may be taken at \$5 per ton H_2SO_4, produced in the form of dilute acid of a maximum of 25 percent trength. Allowing \$4 per ton for concentrating acid, the total cost of acid of 65 percent strength is estimated at not over \$9 per ton equivalent H_2SO_4. Capital cost appears to be about \$4,000 per daily ton H_2SO_4, which is about equally divided between the acid converter and the concentrator.

POLLUTION ABATEMENT

In the last analysis, the problem in abating air pollution from sulphur dioxide requires disposal of large quantities of sulphuric acid from scattered industrial plants, or else the utilization of large amounts of iron sulphate salts, as in the sanitation field. However, the indicated cost of producing commercial sulphuric acid or iron sulphates from waste SO_2 gases is well below the market value of these products. This suggests possible market adjustments to utilize these products and at the same time to minimize an air pollution problem of long standing. An interesting corollary is the possibility of employing obnoxious SO_2 gas, or waste ferrous sulphate, to produce cheap ferric sulphate for sewage and water treatment.

It has been shown[7] that by purchasing crude sulphur in carload lots, ferric sulphate may be produced locally at a cost not exceeding \$20 per ton $Fe_2(SO_4)_3$, or ferrous sulphate at a cost of about \$10 per ton copper as ($FeSO_4.7H_2O$) equivalent. The status of stream pollution from domestic and industrial wastes, and its magnitude, are covered in the comprehensive Report of the Ohio River Committee on Ohio River Pollution Control.[13] This report cites chemical coagulation (e.g., with ferric sulphate) as a logical adjunct to present standard methods of treating domestic sewage and many industrial wastes. Further research is recommended to cheapen present treatment costs. Therefore, a cheaper source of coagulating chemicals appears to be one of the important factors in the future expanded program of treating domestic sewage and industrial wastes. The autoxidation process is believed to meet these requirements.

In conclusion the writer wishes to express appreciation to the various mining organizations that have made contributions to this process development, as well as to H. F. Johnstone for suggestions on air pollution control, to L. W. Briggs and the Western Precipitation Corp. for sponsoring tests using this process for acid production, and to Dario Travaini and the City of Phoenix for continued cooperation in plant demonstration of this process.

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Chemical Engineering Concept in STEEL INDUSTRY

The steel industry as a whole conducts a formidable array of operations. Even filtration, distillation and evaporation are not strangers within its gates, although steel itself is not filtered, distilled or evaporated. It is not idle talk to say that the chemical engineering concept is well diffused throughout the steel industry. With a diversity of operations, and most of them involving considerations which in principle are familiar to the chemical engineer, it would be strange indeed if the steel industry did not afford his talents a field of application which would keep him busy.—*Editors.*

STEEL in the course of its production for the market is not evaporated, distilled, or filtered, nor is it subjected to some of the other interesting unit operations which daily stimulate the mind of the professional chemical engineer. This narrowing of the field does not by any means exclude the chemical engineer nor the chemical engineering concept from the steel industry, for of course there is much more to the story.

Both the engineer and the concept have been mentioned because it is assumed, quite naturally, that the one is the highest exponent of the other. At this point one might indulge in a very unprofitable and useless discussion, debating whether the chemical engineering concept is the exclusive property of the chemical engineer, and then erroneously imply that the chemist, the physical chemist, metallurgical engineer, and the physicist are all devoid of such mental equipment. The foregoing is merely a list of names or titles which have a varying significance, useful in some respects as labels, but they are not specifications. The kind of thinking, rather than the designation of the thinker, is the important consideration—and it is known that chemists and metallurgists are familiar with certain engineering considerations. One should realize, however, that while the chemical engineering concept may be shared and used by others, a chemist who is proficient with a stillson wrench or a physicist who can open and close valves is hardly yet exercising the characteristic function of a chemical engineer.

The steel industry as a whole conducts a formidable array of operations. Even filtration, distillation, and evaporation, as mentioned above, are not strangers within its gates, although steel itself is not filtered, distilled, or evaporated. Admitting that the imprint of metallurgy is strong at almost every turn, one must always remember that the winning of iron from its ores is essentially a chemical process, that the production of steel from iron likewise calls into play a complicated series of chemical reactions, and that the final results are obtained with no mean application of specialized engineering to the various chemical operations involved. If a technologist is interested in both the theory and practical bearing of heat transfer, combustion, rate of reaction, homogeneous and heterogeneous equillibrium, distribution ratios, thermodynamics, diffusion, absorption, adsorption, and the colloidal as well as the crystalline state, and if such matters are rightly the concern of the chemical engineer, the initial steps alone of the steel-making process will afford a wide range for the exercise of his talents. The chemical engineering concept is certainly a factor here, and continues to be a factor in practically all of the operations of the steel business.

Without following the orthodox course of defining the concept itself for the benefit of a group of experienced chemical engineers who already know full well what it is, let us proceed to examine some examples of the bearing of the chemical engineering approach on the many problems in the steel industry.

First of all, there is the old but interesting case taken from the early history of the blast furnace. The operators long ago discovered that in the exhaust gases from the furnace there was a substantial percentage of carbon monoxide. Apparently here was a large quantity of good reducing agent not doing its work, simply going to waste. The remedy, they thought, was to keep the gas longer in contact with the ore so that full advantage might be taken of the reducing properties of the carbon monoxide. Forthwith the blast furnaces were built taller and taller, at considerable expense, but without the realization of any noteworthy benefits. Finally, some one who was familiar with the far-removed research of the day explained to the blast furnace operators that the carbon monoxide was quite powerless, under the conditions, to act further as a reducing agent, as it had already reached the concentration prescribed by chemical equilibrium. In the gas phase in contact with iron oxide at the temperature, it was shown that the molal ratio of carbon monoxide to carbon dioxide should be and was approximately 2 : 1, and that additional time in the reaction chamber would be to no avail. The equilibrium constant had blown its whistle and the carbon monoxide content was through working in the blast furnace. Thereafter this useful constituent of the exhaust gases was put to work in other ways, mainly as fuel, and today contributes its important bit to the 90 percent thermodynamic efficiency of the modern blast furnace.

Iron ore, as you know, is the primary raw material of the steel industry. In this country, with a developed steel-making capacity of 92,000,000 tons of ingots per year, enormous quantities of iron ore are mined to meet the requirements. Fortunately we have in the United States vast workable deposits of iron ore, much of which is susceptible to mining by open pit methods. The high grade deposits, that is, those having 50-55 percent iron content will not last forever. Some day, further in the future than the alarmists prophesy, reliance will have to be placed on the secondary reserves, of which there are many millions of tons. The iron

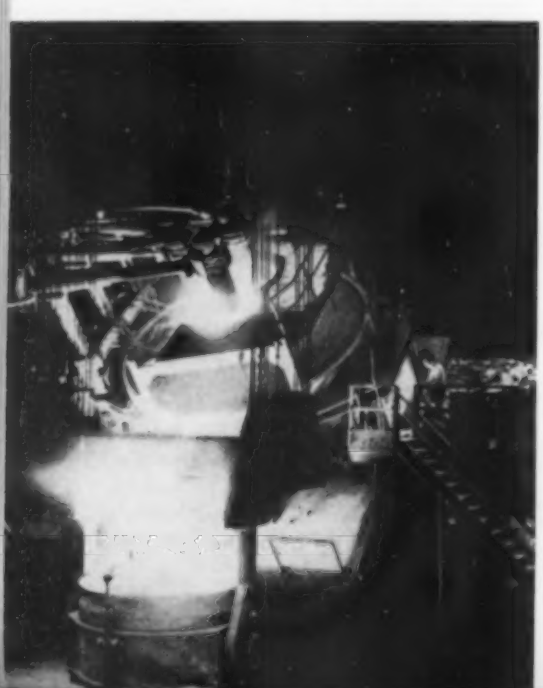
An address delivered at a Symposium on Radiant Energy and Gaseous Reaction, Pittsburgh Section, American Institute of Chemical Engineers, Apr. 19, 1946.

content of these reserves is considerably lower, say 40 percent, and at 30 percent there are additional quantities available. Long before the time when transition from rich to lean ores is imperative, the steel industry must know how it is to proceed.

One important avenue is through the concentration of the leaner material. Already this problem is well under way, in fact noteworthy tonnages of beneficiated iron ore are being produced and used. Year by year the scope of the research work is enlarged, with the aid of chemical engineers and chemical engineering principles. The problem is not a simple one, for there are differences in the chemical and physical constitution of the ores, prescribing different combinations of unit operations in the necessary treatment. All of the way from grinding of the ore to the selection of effective flotation reagents, or from electromagnetic separation with or without prior partial reduction to the development of sink-or-float media, much work must be done. Beyond the actual concentration there are the questions of modulizing, pelletizing, or sintering, and the proper handling of such fines as are worthy of consideration. Moreover, some one will have to decide how far the concentration of the ore should be carried, and at what point the burden of removing impurities should be passed along to the blast furnace, so that the lowest over-all cost may be attained.

Another raw material which is the subject of increasing study is the coal used in producing coke for the reduction of iron ore. Here the important point, aside from the mechanical removal of excessive ash-forming constituents, is the reduction of the sulphur content. Low-sulphur coking coals are becoming scarce, and as the supply dwindles, higher sulphur coals must necessarily be used. As the sulphur content of the coke increases there is a tendency toward higher sulphur in blast furnace iron, and this trend is undesirable in subsequent steel-making practice.

A caldron of chemical activity—70-ton electric furnace in tilting position



Methods for removing a good proportion of the inorganic or pyritic sulphur content from coal have been developed, but the chemical engineers are not optimistic about reducing the organic sulphur. Neither are they enthusiastic over the prospects of removing the resultant and residual sulphur from the coke, economically, while it is in the byproduct ovens, by recirculating hydrogen from the off-gases through the hot mass. On the basis of the data presently available, one school of technologists points to the blast furnace operation as the place for practicing desulphurization, while another school chooses to treat the steel with a special molten mixture as it flows from the open hearth of bessemer converter into the ladle. There appears to be merit in both of these propositions. With many chemical calculations, additional engineering, and further experimental work there is high hope that the cheapest and most effective procedure will be developed. Meanwhile, as another line of attack on the problem, studies of the blast furnace operation are being made to determine whether the control of factors other than sulphur input may result in the production of low-sulphur iron.

LARGE REACTION CHAMBER

The modern blast furnace, as has been said, is a very large reaction chamber of approximately 45,000 cu.ft. capacity, in which chemical processes are conducted at elevated temperatures. Its principal function is the reduction of iron from ore, using coke as the source of both heat and reducing agents, and limestone as flux. Were this entire paper to be devoted to a discussion of the blast furnace process, only a small fraction of the interesting chemical features of that operation could be covered. The paper, however, is not a thesis on the blast furnace; its objective is to deal with the chemical engineering aspects of the steel industry. The chemical engineering concept, with respect to the blast furnace and its performance, exhibits many facets, of which a few will be mentioned as samples.

Heterogeneous equilibrium, as a method of study, is here in all its glory. If only one master reaction were in progress inside the blast furnace the process would be relatively simple, and a single chemical equation might represent what was taking place. As a matter of fact, at different levels in the furnace, and therefore in different zones of temperature ranging from around 300 deg. to 3,000 deg. F., a series of reactions are continually proceeding toward their respective states of equilibrium. Whatever Fe_2O_3 is charged into the top of the stack—in this country it usually predominates—is first reduced to Fe_3O_4, which at a lower level goes to FeO, and the FeO in turn yields the last atom of oxygen and becomes metallic iron. Most of the reduction is accomplished by the rising stream of carbon monoxide, but there are additional reducing reactions taking place at the slag-metal interface near the bottom of the furnace where carbon, or more properly iron carbide, and FeO come to grips. Impurities in the charge give rise to complicating side reactions, and the slag system furnishes another interesting and profitable field for continued investigation, as its function is an extremely important one.

EQUILIBRIUM CONDITIONS

Even though equilibrium conditions may not be fully realized in the many stages of blast furnace operation, the equilibrium concept is a useful tool in all pertinent investigations because it specifies trends and sets limitations. The operator himself may be more immediately interested in what the chemical engineer can tell him about the reactivity of the coke, rates of reaction, distribution ratios, and gaseous diffusion, but those matters must be fitted into the framework set by the laws of chemical equilibrium.

The steelmaker, supplied with iron from the blast furnace, proceeds with the making of steel ingots—to a great variety of chemical specifications. He has at his disposal, and subject to his choice, the bessemer converter, the open hearth, and the electric furnace. All three of these facilities are in use in this country and all three of the processes are of direct interest to the chemical engineer. From the standpoint of tonnage produced, the open hearth process far outranks the others, accounting as it does for approximately 90 percent of the annual output of steel ingots in this country. It has been the subject of a vast amount of scientific study, and there is room for more.

In contrast with the reducing characteristics of the blast furnace, which operates continuously, the open hearth furnace is of oxidizing persuasion, and produces steel in batches or "heats." Here the main metallic ingredients of the charge are iron, preferably molten if a blast furnace is nearby, and steel scrap, in proportions which may and usually do vary considerably from a half-and-half ratio. Limestone or lime is added as a flux or slag-making constituent, and iron ore is furnished in proper proportions to act as an oxidizing agent. The charge is heated by direct flame to temperatures around 3,000 deg. F. After it has melted and the slag has formed, the refining reactions proceed until the molten metal is ready for removal from the furnace.

There are many reactions. The metallic charge contains excessive percentages of carbon, silicon, phosphorus and manganese, most of which are to be lowered by the action of the oxidizing agent, iron oxide, aided to some extent by the oxidizing flame and furnace atmosphere. The slag-metal interface is one of the busiest spots in the furnace, for here many of the reacting sub-

Bessemer converter offers chemical engineers a field of direct interest

stances are sure to meet and strive for equilibrium. Any attempt to regulate the performance toward optimum results must take into account such important factors as temperature, rates of reaction, energy relationships, various solubilities—particularly those of ferrous oxide in both metal and slag—physical agitation, and slag viscosity as well as basicity. This list is not complete, it is merely illustrative.

Now it happens that all of the desirable objectives of the open hearth process cannot be attained without overreaching some of them, whereby another interesting set of problems arise from the necessity of deoxidizing the steel, or ridding it of an excess of purifying agent. These problems and the manner of their solution have a profound influence upon the metallurgical and engineering properties of the finished steel, hence they occupy an important place in the physical chemistry of steel-making. Deoxidation practice and the final adjustment of chemical composition by the use of addition agents, both before and after the steel is tapped from the furnace, may either bring to full fruition or render useless the earlier care bestowed upon the operation. Moreover, throughout the process, chemistry and engineering must not desert the furnace operator in his efforts to accomplish the best end result as quickly and economically as possible.

PROBLEM OF HEAT

To the chemical engineer who has a flair for working with problems involving combustion, radiant energy, heat balance and heat exchange, the steel industry affords a hundred operations for the exercise of his talents. The blast furnace and open hearth processes, already mentioned, are good examples, for they are noteworthy users of heat at high temperatures. Beyond them in sequence lie many heating operations incident to the rolling of ingots to numerous finished forms, and let it be said that proper heating is of as much importance as proper mechanical working in contributing to the high quality of the finished product. Then there is the matter of precise heat treatment for the development of specified sets of physical properties. This is a major consideration in the processing of steel, and the procedure involves not only the application of heat at controlled temperatures, but also the proivsion of protective atmospheres to prevent oxidation on one hand, and the decarbonization on the other. Hot gases and hot metal in contact make interesting studies.

Would you be willing to admit that the pickling of steel, or removal of surface oxide by treatment of the material in hot solutions of sulphuric acid, partakes of the nature of chemical engineering? The pickling of strip, sheets, wire, and many other products is one of the important operations of the steel industry. For the good of the product as well as of the cost sheet, this process must be conducted with a full knowledge of the effects of time, temperature, acid concentration, inhibitors, neutral salt concentration and the presence of incidental contaminants. In the case of steel products which are to be coated subsequently with other metals such as zinc and tin, the matter of precise control of the cleaning and etching action has a determining effect upon what follows.

Incidentally, what would you do with the spent pickling solutions when they have reached the point of discard due to their build-up concentration of ferrous sulphate? Various laws and regulations indicate quite clearly that these waste liquors are considered undesirable contaminants in streams and other public waters and that when the heavy pollution load is lifted from our watercourses, all spent pickling solutions must likewise be eliminated. From the chemical engineering viewpoint you may say that the problem is relatively easy,—simply select and adopt the best one of 80 or more methods already proposed and consider the assignment finished.

BYPRODUCT COKE PLANT

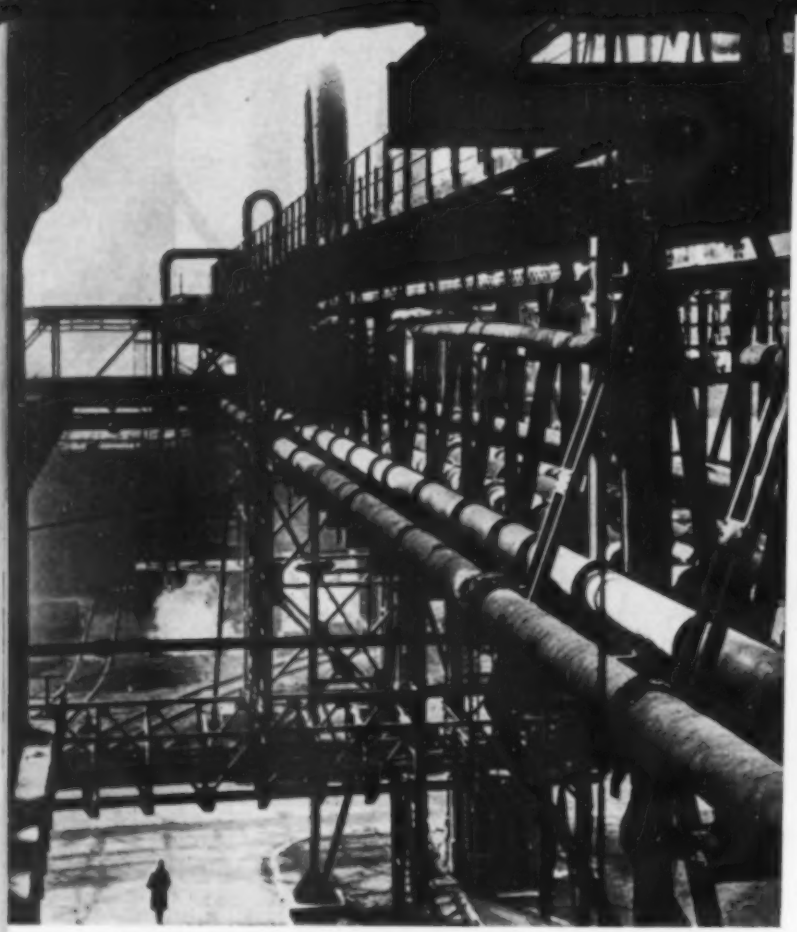
As a final example in this recital of interesting subjects with which the steel industry is continually dealing, let us walk across the way from the steel-making facilities and take a hurried look at a byproduct coke plant. For obvious reasons, many such plants in this country are operated as an integral part of the steel business. Here the chemical engineer may give free rein to some of his most cherished lines of thinking, without being annoyed by the presence of too many metallurgists. He comes face to face with such operations as destructive distillation, the application of radiant heat, absorption, scrubbing, rectification, washing, drying, and handling of large volumes of gaseous mixtures, extractive and azeotropic distillation, and the production of a varied line of chemicals from the products already produced. What to do about the sulphurous constituents of the coke oven gas, can waste pickle liquor from the steel mills be used advantageously instead of sulphuric acid in the production of ammonium sulphate, would it pay to separate the ethylene fraction, how best to purify the benzol to meet the progressively higher standards of the trade—these are a few of the practical questions which the chemical engineer must answer. And whenever there is a troublesome waste product which cannot, for legal reasons, be run into the sewer, it is usually run into the lap of the chemical engineer.

Were it not for these and many other problems relating to the production of coal chemicals, one might say that the byproduct coke plant was a chemical engineering Garden of Eden, except that there is no tree of forbidden fruit, the only serpent is the electrician's snake which cannot talk, and any Eve about the place is fully clothed and confined to the office.

In view of all of the foregoing, which necessarily had to be limited to a mention of illustrative examples and suggestions, it is not idle talk to say that the chemical engineering concept is well diffused throughout the steel industry. With such a diversity of operations, and most of them invoking considerations which in principle are familiar to the chemical engineer, it would be strange indeed if the steel industry did not afford his talents a field of application which would keep him radiant with energy.

BRITAIN'S

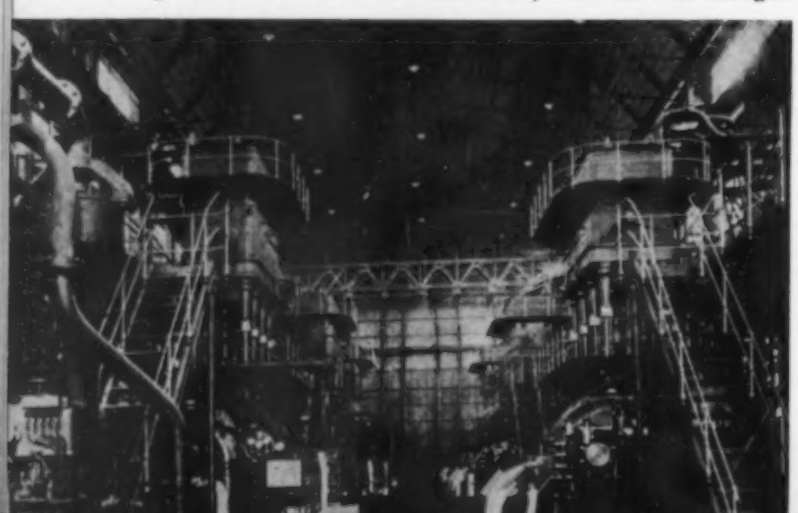
A SIGNIFICANT part of Great Britain's industrial activity is based on its chemical industry. One of the oldest branches of this field, essential to agricultural production, is the manufacture of fertilizer. Beginning in the second half of the 19th century, chemists and chemical engineers pioneered in what is now an important segment of the whole British economy. That this foundation was sound is obvious from the present scale of operations. Many of the processes, operations and equipment are similar to those used in this country but others appear to be unique. Among these is the commercial production of hydrogen from steam and carbon monoxide (occurring as an impurity in water gas) and another is the adoption of spray drying towers for drying concentrated slurries of fertilizer materials.



Services such as steam, power and water are distributed to various parts of the fertilizer plant by means of pipe bridges

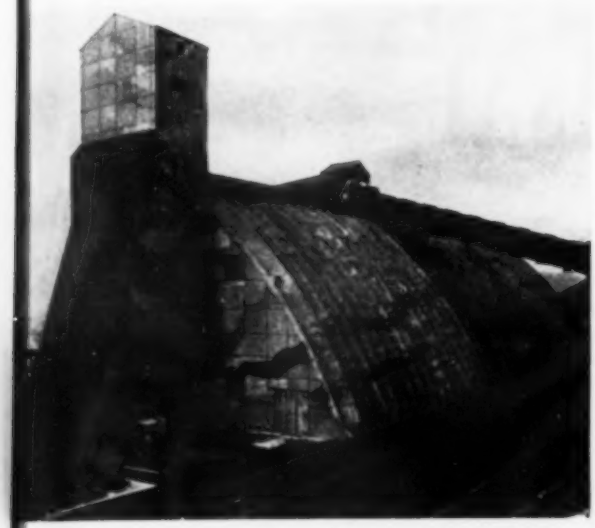
Steam and carbon monoxide react here to form hydrogen

Hydrogen under high pressure from these 3,000-hp. compressors is converted to ammonia by reaction with nitrogen

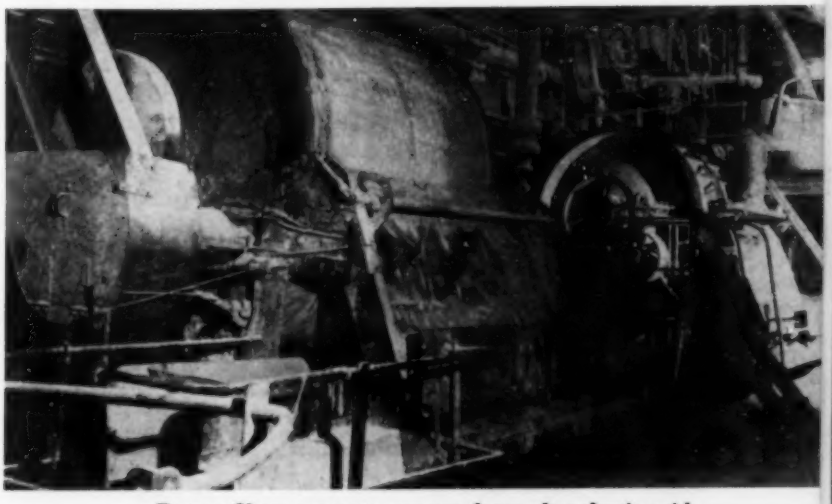


Ammonium sulphate stored in conditioned silos

FERTILIZER INDUSTRY

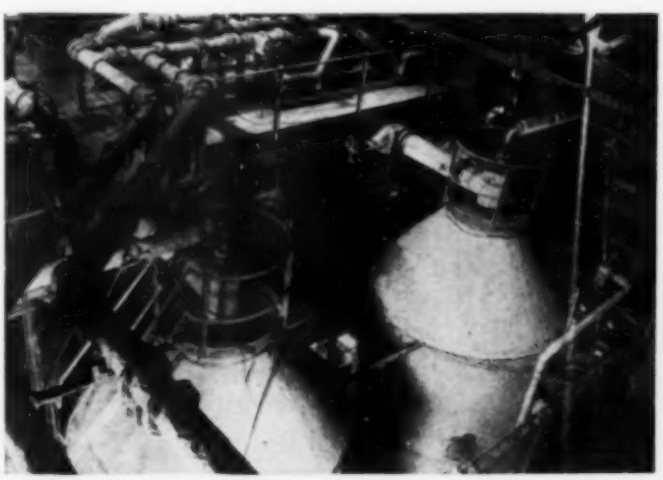


Exterior of an air conditioned silo which has a capacity for 100,000 tons of ammonium sulphate

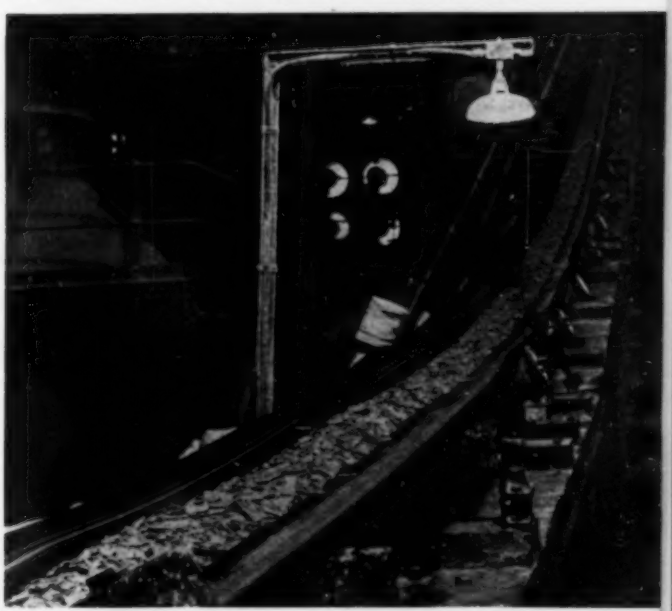


Rotary filters separate gypsum from phosphoric acid

Finished fertilizer in the form of flakes are transferred to storage by means of this belt conveyor

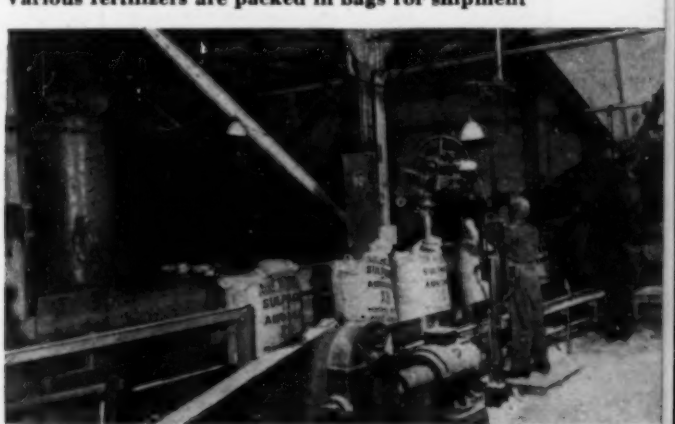


View showing the 200 ft. high towers in which a concentrated slurry of ammonium nitrate and chalk is spray dried



Spray nozzles at the top of the drying towers shown above

Various fertilizers are packed in bags for shipment



C. C. HERMANN *Consulting Engineer, Grosse Pointe Park, Mich.*

Practical Methods Used for DUST DISPOSAL

This is the fourth and last of our series on dust control in the process industries. Previous articles have given practical information on the design of hoods, air ducts and dust collectors. Here the author discusses important methods used in the final disposal of solid materials delivered by the dust collection system.—*Editors*

FINAL disposal of collected solids should be an integral part of any dust collection system. While some types of dust do have a salvage value, many such materials are not worth salvage and must be disposed of in a manner to prevent additional nuisance. Such disposal is not always an easy problem, but it may usually be solved by one of three methods, namely: (1) Salvage the collected dust where a salvage value is apparent; (2) destroy the collected material by burning; (3) wet down and deposit the collected material in suitable areas.

Salvage methods are often complex and involve considerable labor and equipment expenditure, sometimes out of proportion to the value of the residue. The collector system picks up material which is valueless as well as that which is worth recovering. For example, a dust collecting system for magnesium dust from grinding operations picks up nearly as much waste material by weight as it does magnesium. The materials are thoroughly mixed and must be separated in any salvage operation. Although methods have been devised to salvage magnesium, the actual quantity of dust obtained from a given plant is often insufficient to warrant an installation.

There have been many attempts to salvage abrasive materials picked up by dust collector systems. Usually these systems are for large grinder and polishing installations where the abrasive, when salvaged, may be reused. In such salvage systems the material must be passed over a magnetic separator to remove the metal, and then through a furnace to burn out the combustible material such as glue, lint, etc. After this operation the material is again passed over a magnetic separator to remove any metal particles loosened by the high temperature, and then the salvaged abrasive is screened and graded for reuse.

Many types of dust which are comparatively pure or uncontaminated may be sent directly back to the process. This includes such materials as chemicals, sugar, starch, flour, cereals, and other similar products. Various plastics are reclaimed from machining operations and reused directly. Dyes, paint and germicide plants salvage practically 100 percent of their dust by filtering the dust which is then reused. In the dye industry, and particularly in the case of refractory mineral colors, the collection system pays dividends.

Any salvage method must take into account the explosive characteristics of the material collected. Such materials as aluminum, antimony, cadmium, magnesium, tin, titanium, zinc, zirconium, black powder and TNT have a definite fire and explosion hazard and must be handled accordingly. In many cases the volume of dust collected is small, making salvage operations uneconomical, and the material is often destroyed by burning.

One of the most satisfactory methods to handle waste dust is by suitable method of wetting. Dry type collectors present a very difficult problem of extracting the collected dust without producing a dust hazard similar to the original dust condition. The dust is separated from the conveying air stream by use of such devices as filter bags. The bags discharge into a hopper and must then be emptied without further dispersion of the dust.

Numerous devices are used for emptying dry dust from dust collector hoppers. In Fig. 1 is shown the simple slide valve

Fig. 1—Commonly used slide valve; Fig. 2—Continuous dribble type valve

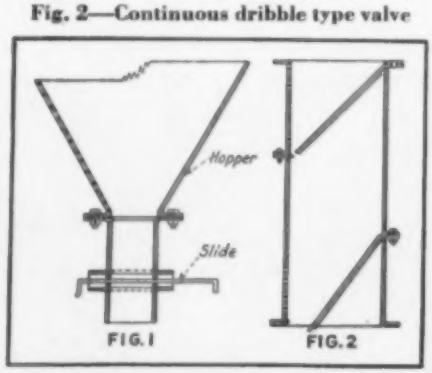


Fig. 3—Continuous rotary valve (American Foundry Equipment Co.)

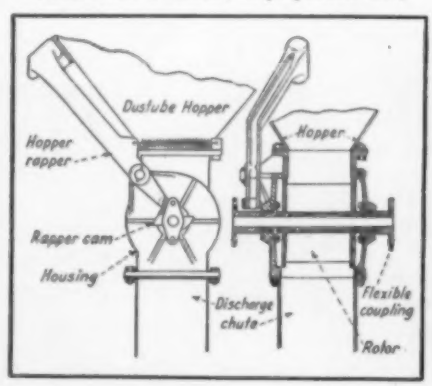


Fig. 4—Gravity sludge disposal system (Claude B. Schneible Co.)

Fig. 5—Twin type settling tank (Claude B. Schneible Co.)

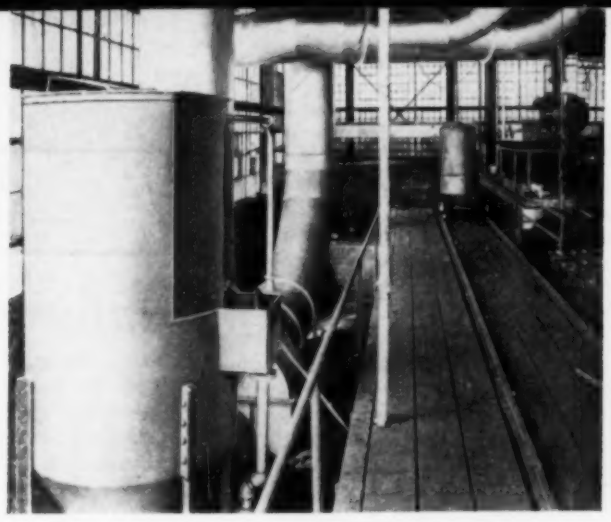


Fig. 6—Schneible continuous disposal system

used for dumping the contents of the hopper into bags, closed containers, or trucks. The slide is located and sealed by felt seal rings.

Fig. 2 illustrates a dribble type valve used for continuously unloading the dust from the hopper. The valve is provided with two rubber valves each with a steel stiffening plate and spring-loaded against a predetermined weight. The valves are positioned far enough apart to give a small capacity between them, forming an air lock. As the dust load overcomes the upper valve spring, this valve opens, allowing the dust to descend into the chamber to the lower valve. As the chamber fills, the upper valve closes and the lower valve drops open, depositing the dust into the container or vehicle below.

A continuous type rotary valve is shown in Fig. 3. This valve is adapted for motor drive by reduction gear and where a number of collectors are installed in a row the entire group of valves may be operated by connecting them to a single motor and drive. Since the dust tends to solidify and bridge over in the hopper, an auxiliary rapping device is provided to prevent arching. The operating shaft is provided with a cam which operates the rapper. Thus the side of the hopper is vibrated by the rapping device which prevents the material from arching, and insures a constant flow.

DISPOSAL METHODS

The preceding devices are designed for dry dumping, although they may also be used with wet disposal methods. When a wet disposal system is used in conjunction with the dry type of collector the wetting takes place immediately beneath the collector discharge valve. The material is dribbled or dumped into a trough of running water which carries the dust to a settling tank. Here the solids are allowed to settle out and the water is cycled back to the far feed end of the trough. The trough is sloped to give the water a velocity of not less than 7 ft. per sec., which can usually be obtained by a slope of 1 ft. in 30 ft.

Wetting the dust is one of the most satisfactory methods for handling. In this system the dust becomes a heavy sludge and must be conveyed in tanks to the disposal point. There are three choices of wet disposal systems: (1) Drain by gravity or force pumping to the disposal ground, which is generally a low area in the vicinity of the plant. (2) Drain by gravity or force pumping to a settling tank, allow the clear water to flow off, leaving a solid mass which can be removed from the bottom of the tank. (3) Allow the solids to accumulate in a tank until the concentration of the slurry is about at its maximum, and then pumping the highly concentrated slurry to the disposal grounds.

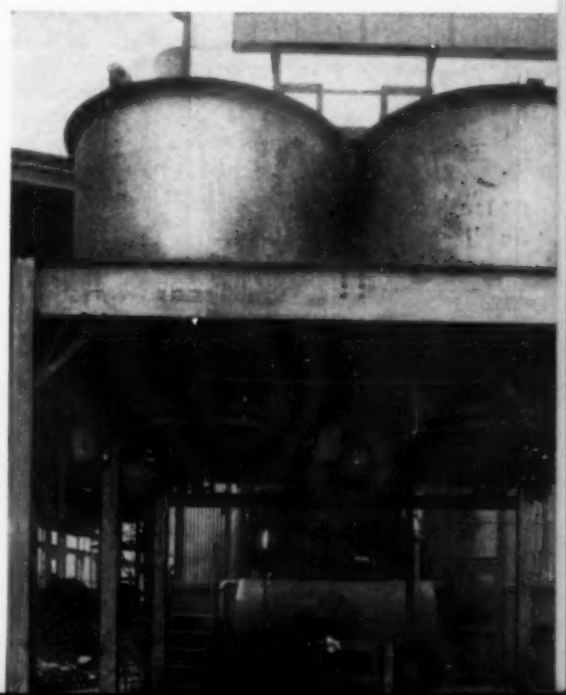
The first method is often used where it is desirable to fill low areas. Many acres of otherwise valueless ground area have been reclaimed in this manner and later used for building sites. Fig. 4 illustrates a dust collector installation in which the sludge is piped direct from the bottom of the collector to such an area. In this case all of the water used in transporting the dust must be drained away through the soil. The disposal area must be of sandy soil so that the water seeps away fast, even during the cold months of the year.

In Fig. 5 is shown a concrete settling basin divided into two compartments, one of which is used while the other is being drained and emptied of the solids. Such settling basins have been made to contain ten carloads of solids. In one end of the tank is located a weir, skimmer plate, and a series of dewatering baffles. The clear water flows over the weir, into the drainage compartment, the floating material being held back by the skimmer plate. When the tank is nearly full of solids the inflow pipe is changed over to the second tank and the dewatering gates are opened. Surplus water is drained off until the moisture content of the solids is low enough to permit handling by grab buckets operated by a crane. The solids are then transported to the final disposal grounds by means of trucks or railroad cars.

A small settling system which operates continuously with regard to recirculation of the liquid as well as the sludge is shown in Fig. 6. In this case a low area near the plant was available. The settling tank consists of a cone bottom tank, to which the water-bearing solids flow by gravity from the dust collector. The solids settle into the cone bottom while the comparatively clear water is drawn off the tank just beneath the operating level and recirculated to the collectors. Another pump draws the sludge from the bottom of the cone and pumps it to the disposal area.

Still another type of disposal system is shown in Fig. 7. Here large circular tanks are used for settling the solids of the water. In the installation shown, four such tanks are used, each having a capacity of 2,000 gal. Each tank is provided with hinged doors at the bottom for dumping the dewatered solids into trucks. In operation, half of the tanks are on stream during the time the other half are being dewatered and dumped. The water carrying the solids from the dust wetting operation at the collectors enters the tank through manifold piping located above. The outlets are hooked up so that the liquid is directed

Fig. 7—Schneible dewatering system



to the desired tanks. The tanks are kept in the circuit until about half full of solids, at which time the effluent passes to the clean tanks. The dewatering cycle is then started. This phase of the system consists of a suitable pump taking its suction from the low side of a set of dewatering louvers, tending to pull the water out of a body of solids. When the moisture content of the solids has reached a predetermined point the load is dumped by opening the bottom doors into a dump truck, railroad car, or other suitable carrier.

PRACTICAL POINTERS

In all of these systems a severe pumping and draining system is required. Liquids containing abrasives, such as sand, silica, steel, silicon carbide, etc., and other similar materials, are difficult to handle. The volume of such solids should not be greater than 12 percent of the liquid volume. An important factor in any sludge lines is that of slope. Where the slope of the pipe is too low, solids are deposited in the pipe. Where the slope is too great, build-up along the pipe sidewalls occurs to the point that heavy accumulations eventually break down tending to plug the pipe.

For best results the pipeline should be designed to run about three-fifths full at all times at a velocity of about 7 ft. per sec. It is important to select the right size of pipe. If the pipe runs full, it is too small for flexibility. If the pipe is too large, the low water flow may result in solids being built up in the bottom of the pipe and sooner or later causing trouble.

All elbows should be of long radius and all fittings should be eccentric to present a smooth continuous bottom throughout the length of the pipe. Welded joints are preferred, provided no weld bead is left on the inside of the pipe. Screw and flanged joints provide obstructions to cause settling of solids which eventually build up and plug the pipe. The line should be as straight as conditions permit, and provisions should be made to vent the high point of all lines to the atmosphere. The useful life of such lines depends upon the type of solids handled. Some distribution lines have been in use for periods of three to five years before repairs were necessary. Critical points are at turns and elbows. These cut out very rapidly and various designs have been experimented with in an effort to reduce the wear. Using rubber-lined elbows or even eliminating the elbows by substituting tees have been tried with little success. Patching of the pipe by welding is also a waste of time, since the wall is probably worn thin for its entire length, and even if this is not the case the wear will be accelerated at the low point of the patch. Branch lines joining the main line should enter at the top rather than at the bottom or sides, and the junction should be at the smallest possible angle.

NUCLEAR FRONT

(*Continued from page 125*)

more, U-235 and plutonium can be denatured. Such denatured materials do not readily lend themselves to the making of atomic explosives, but may be still be used with no essential loss of effectiveness for peacetime applications of atomic energy. They can be used in reactors for generation of power or in reactors useful in research and in the production of radioactive tracers. Denatured materials are unusable by any known method for effective atomic explosives unless steps are taken to remove the denaturants. To do so calls for rather complex installations which, though not on the scale of those at Oak Ridge or Hanford, nevertheless would require a large effort and, above all, scientific and engineering skill of an appreciable order for their development.

(In a later release, a committee of outstanding scientists connected with the Manhattan Project issued a statement concerning denaturing. Among other things this release stated: "The report does not contend, nor is it in fact true, that a system of control based solely on denaturing could provide adequate safety. All atomic explosives are based on the raw materials uranium and thorium. In every case the usefulness of the material as an atomic explosive depends to some extent on different properties than those which determine its usefulness for peacetime application. In every case denaturing is accomplished by adding to the explosive an isotope which has the same chemical properties. These isotopes cannot be separated by ordinary chemical means. The separation requires plants of the same general type as our plants at Oak Ridge, though not of the same magnitude. The construction of such plants and the use of such plants to produce enough material for a significant number of atomic bombs would probably require not less than one and no more than three years. Even if such plants are in existence and ready to operate some months must elapse before bomb production is significant. But unless there is reasonable assurance that such plants do not exist it would be unwise to rely on denaturing to insure an interval of as much as a year.

"For the various atomic explosives the denaturant has a different effect on the explosive properties of the materials. In some cases denaturing will not preclude making atomic weapons, but will reduce their effectiveness by a large factor. The effect of denaturing is also different in the peacetime application of the materials. Further technical information will be required, as will also a much more complete experience of the peacetime uses of atomic energy and its economics, before precise estimates of the value of denaturing can be formulated. But it seems to us most probable that within the framework of the proposals advanced by the State Department report, denaturing will play a helpful part.

"In conclusion we desire to emphasize two points, both of which have been challenged in public discussion. (1) Without uranium as a raw material there is no foreseeable method of releasing atomic energy. With uranium, thorium can also be used. (2) Denaturing, though valuable in adding to the flexibility of a system of controls, cannot of itself eliminate the dangers of atomic warfare.")

The Acheson report goes on to state that it is easy to design small nuclear reactors which can use denatured U-235 or plutonium, and can be operated at a power level low enough to be incapable of producing dangerous quantities of fissionable materials, but high enough to provide neutron sources and gamma ray sources of unparalleled intensity. Furthermore, high power-level reactors for the development of power from denatured U-235 and plutonium might operate in the range from 100,000 to 1,000,000 kw. without producing further fissionable materials if there were no additional uranium or thorium present. A minimum of supervision should make it possible to prevent the substitution of uranium or thorium for the inert structure of the materials of these reactors. Thus, a great part of the field of atomic energy can be opened with relative safety to competitive activities under license of the international organization.

The first major group of functions of the international atomic development authority, then, would be to maintain complete control of the world supply of uranium and thorium, to carry out all mining and refining, to own all stockpiles and to sell by-products such as vanadium and radium. The Authority would necessarily supply uranium and thorium for present limited commercial uses. The second group of functions would be the construction and operation of atomic reactors and separation plants and the carrying out of extensive research in connection with all phases of atomic energy. Another function would be to license private and national interests to carry out safe operations, and to lease the denatured fissionable materials needed for such operations. And, finally, the Authority would have the function of inspection, primarily directed toward the control of raw materials.

In regard to personnel, the makeup of the Authority would include all the various nationalities involved. Furthermore, to avoid fear on the part of individual nations, dangerous operations of the Authority would be located within the borders of many countries so as to maintain a balance. Thus, seizure of any one of the Authority's plants or laboratories would be an immediate danger signal, averting possibility of a surprise attack, while the atomic explosives produced in plants in other countries could, it is hoped, be relied upon to enforce international demands upon recalcitrant nations.

RALPH GIBBS *Chemical Engineer, York, Pa.*

Estimating Best Output and Fuel Rates of WET-FEED LIME KILNS

Last month in a companion article the author told how to evaluate a dry-feed rotary lime kiln. Equations were developed for calculating the maximum production rate and minimum fuel consumption of which any given kiln is capable. This article concludes the analysis by developing comparable formulas for wet-feed kilns.—*Editors*

BEFORE launching into an analysis of production rates and heat requirements for wet-feed rotary kilns it is necessary to restate some of the fundamental relationships presented last month in an analogous article on dry-feed kilns. (The numbering of equations and figures is continuous through the two articles. Equations (1) through (21) and Figs. 1 through 5 appeared last month.)

The optimum production rate for rotary kilns Q_d was given as:

$$Q_d = k\,R_k\,D^3/100 \qquad (3)$$

Total heat requirement for a dry-feed kiln h_{cd} was given as the summation:

$$h_{cd} = h_{cd} + h_{sd} + h_{gd} \qquad (5)$$

Heat loss through the shell h_{sd} was given as:

$$h_{sd} = 4{,}340/k\,D \qquad (7)$$

Temperature of the exit gas T_{gd} was given as:

$$T_{gd} = \frac{4{,}700 + 1{,}550\,D}{R_k} + 287 \qquad (11)$$

The normal time-rate heat requirement H_n was found to be:

$$H_n = 0.000625\,R_k\,D^3 \left(\frac{0.25\,T_e + 1{,}630 + 2{,}890/D}{501.4 - (556 + 183.3D)/R_k}\right) \qquad (21)$$

WET-FEED KILNS

Knowing the normal time-rate of heat supply to the dry-feed rotary lime kiln normally operated, and postulating the same heat supply to any similarly dimensioned wet-feed rotary kiln, it is possible to approximate the new production coefficient k_w, and the new heat requirement H_{cw}.

HEAT UTILIZATION

The total heat requirement in a wet-feed kiln is apportioned as in a dry-feed kiln, that is, as in Equation (5). But because of the moisture in the kiln feed, all individual heat requirements (h_{cw}, h_{sw}, h_{gw}) will be quite different from those in the case of the dry-feed kiln.

HEAT FOR CALCINATION

Fig. 6 shows graphically the computed values of h_{cw} for kiln feed containing various quantities of water. These relations closely follow the form:

$$h_{cw} = (0.25\,T_e + 1{,}630)\,(1 + R_f) \qquad (22)$$

KILN SHELL LOSS

Since the wet feed will change the production rate of the kiln from that of the same sized kiln with dry feed, the production coefficient k_w will be changed and unknown. Consequently any kiln shell heat loss relations now will have to retain k_w as an unknown. (In the dry-feed kiln k could be taken as a constant, 1.5). Thus Equation (7) will now appear as:

$$h_{sw} = 4{,}340/k_w D \qquad (23)$$

EXIT GAS LOSS

Fig. 7 shows the computed heat loss in the exit kiln gases for various water contents in the kiln feed, for various temperatures, and for various H_{cw}. These relations are rather closely reproduced by:

$$h_{gw} = (0.882\,R_f + 0.118\,H_{cw})\,T_{gw} - (264\,R_f + 35.4\,H_{cw}) \qquad (24)$$

which can be algebraically rearranged to the expression:

$$h_{gw} = 35.4\,H_{cw}\,(0.00334\,T_{gw} - 1) + R_f\,(0.882\,T_{gw} - 264) \qquad (25)$$

And once again, as in the case of the dry-feed kiln, the problem of establishing some reasonable, normal exit gas temperature manifests itself.

EXIT GAS TEMPERATURE

There is just as much uncertainty about the normal wet-feed exit kiln gas temperature as there is with the dry-feed kiln gas temperature. However, gases from wet-feed kilns are, without special heat exchange arrangements, substantially lower in temperature than those from dry-feed kilns under similar general operating conditions. The writer proposes therefore, in the absence of anything better, the following relation:

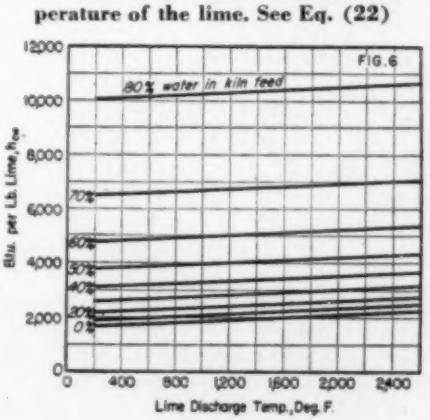
$$T_{gw} = T_{gd} - 200\,R_f \qquad (26)$$

And substituting (11) for T_{gd}, then (26) becomes:

$$T_{gw} = \frac{4{,}700 + 1{,}550\,D}{R_k} + 287 - 200\,R_f \qquad (27)$$

Substituting (27) in (25) will result in:

Fig. 6—Amount of heat to dry and calcine the charge depends on percent water in feed and discharge temperature of the lime. See Eq. (22)



$$h_{gw} = 35.4\,H_{sw}\left[0.00334\left(\frac{4{,}700 + 1{,}550\,D}{R_k} + 287 - 200\,R_f\right) - 1\right] +$$

$$R_f\left[0.882\left(\frac{4{,}700 + 1{,}550\,D}{R_k} + 287 - 200\,R_f\right) - 264\right] \qquad (28)$$

TOTAL HEAT REQUIREMENTS

There are now available all the items for setting up the wet-feed counterpart of (5):

$$h_{sw} = (0.25\,T_c + 1{,}630)(1 + R_f) + \frac{4{,}340}{k_w\,D} +$$

$$35.4\,H_{sw}\left(\frac{15.7 + 5.18\,D}{R_k} - 0.04 - 0.668\,R_f\right) +$$

$$R_f\left(\frac{4{,}140 + 1{,}365\,D}{R_k} - 11 - 176.3\,R_f\right) \qquad (29)$$

And since, by definition: $10^6\,H_{sw} = 2{,}000\,h_{sw}$, or, $500\,H_{sw} = h_{sw}$ (30)

Then:

$$H_{sw} = \frac{(0.25T_c + 1{,}630)(1 + R_f) + \frac{4{,}340}{k_w\,D} + R_f\left(\frac{4{,}140 + 1{,}365D}{R_k} - 11 - 176.3R_f\right)}{501.4 - \frac{556 + 183.3\,D}{R_k} + 23.6\,R_f} \qquad (31)$$

Since the normal time-rate of heat supply was postulated as being retained for both the dry- and the wet-feed kiln, then: $Q_{hw} = H_n/H_{sw}$ (32)

And since, from Equation (3): $Q_{hw} = k_w\,R_k\,D^3/2{,}400$ (33)

Then: $H_n/H_{sw} = k_w\,R_k\,D^3/2{,}400$ (34)

And: $H_{sw} = \dfrac{2{,}400\,H_n}{k_w\,R_k\,D^3}$ (35)

We now have two independent expressions for H_{sw}, namely, (31) and (35). By equating them we can solve for k_w with the result that:

$$k_w = \frac{1.5\left(\frac{0.25\,T_c + 1{,}630 + 2{,}890/D}{501.4 - (556 + 183.3D)/R_k}\right)\left(501.4 - \frac{556 + 183.3\,D}{R_k} + 23.6\,R_f\right)}{(0.25\,T_c + 1{,}630)(1 + R_f) + R_f\left(\frac{4{,}140 + 1{,}365\,D}{R_k} - 11 - 176.3\,R_f\right)} -$$

$$\frac{4{,}340}{D\left[(0.25\,T_c + 1{,}630)(1 + R_f) + R_f\left(\frac{4{,}140 + 1{,}365\,D}{R_k} - 11 - 176.3\,R_f\right)\right]} \qquad (36)$$

In this case k_w presumes a practically complete (98 percent) calcination of the product.

Thus with the establishment of the relation for k_w, Q_{dw} is derived in the usual relation, and H_{sw} either from (31) or (35).

When heat exchangers are used in the feed end of the kiln, then some suitable temperature for the exit kiln gases can be assumed. The manufacturers of this equipment will generally supply some safe and practical temperature that will be attained. Under these conditions (31) becomes:

$$H_{sw} = \frac{0.25\,T_c + 1{,}630 + 4{,}340/k_w\,D + R_f\,(0.882\,T_{gw} - 264)}{535.4 - 0.1182\,T_{gw}} \qquad (37)$$

And (36) becomes:

$$k_w = \frac{1.5\left(\frac{0.25\,T_c + 1{,}630 + 2{,}890/D}{501.4 - (556 + 183.3\,D)/R_k}\right)\left(535.4 - 0.1182\,T_{gw}\right)}{(0.25\,T_c + 1{,}630)(1 + R_f) + R_f\,(T_{gw} - 264)} -$$

$$\frac{4{,}340}{D\left[(0.25\,T_c + 1{,}630)(1 + R_f) + R_f\,(T_{gw} - 264)\right]} \qquad (38)$$

HOW RELATIONS ARE USED

Probably the use and value of the foregoing relations can be best illustrated by citing a specific example. In a paper mill recovering lime from their recausticizing process, a 7-ft.-dia. by 100-ft.-long rotary kiln was used. No heat exchangers were used and no lime coolers were installed. The product contained about 78 percent available lime and was produced at a rate of 39 tons per day. The lime was discharged from the kiln at 2,100 deg. F. Feed to the kiln was 55 percent water. Fuel consumption was about 106 gal. of bunker C (No. 6) oil per ton of product, approximately 15,900,000 B.t.u. per ton of product. The temperature of the kiln gases was approximately 1,150 deg. F. as measured with an iron-constantan thermocouple.

From the actual operation then: H_{sw} is 15.9; R_k is 14.3; R_f is 1.22; D is 7.0; T_c is 2,100 deg. F.; T_{gw} is 1,150 deg. F.; $k = 39/(14.3 \times 3.43) = 0.795$ for 78 percent calcination; or, $k_w = 0.795 \times 0.78 = 0.62$ for 98-100 percent calcination.

From the empirical relations just established, (36) results in $k_w = 0.629$; or $k = 0.629/0.78 = 0.805$.

The close agreement is very noticeable.

From (31) H_{sw} is computed to be 16.0 which is also in good agreement. From (3), $Q_{dw} = (0.805)\,(14.3)\,(343)/100 = 39.5$ tons per day of 78 percent available lime product. From (27), T_{gw} is computed to be 1,133 deg. F.

In view of the fact that the relations used

SYMBOLS

- D = Kiln shell diameter, ft.
- H_{sd} = Total heat supplied to dry-feed kiln, millions of B.t.u. per ton lime produced.
- H_{sw} = Total heat supplied to wet-feed kiln, millions of B.t.u. per ton lime produced. ($H_{sw} \times 6.67$ = Approx. gal. bunker C oil; $H_{sw} \times 74$ = Approx. lb. coal per ton lime.)
- H_n = Normal time-rate heat requirement, millions of B.t.u. per hour.
- h_{sd} = Total heat requirement with dry feed, B.t.u. per lb. lime produced.
- h_{sw} = Total heat requirement with wet feed, B.t.u. per lb. lime produced.
- h_{cd} = Heat of calcination with dry feed, B.t.u. to calcine 1 lb. lime and discharge it at T_c deg. F.
- h_{cw} = Heat of calcination with wet feed, B.t.u. to dry, calcine and deliver 1 lb. of lime at temperature T_c deg. F.
- h_{ld} = Shell heat loss with dry feed, B.t.u per lb. lime produced.
- h_{lw} = Shell heat loss with wet feed, B.t.u. per lb. lime produced.
- h_{gd} = Heat lost in exit kiln gas with dry feed, B. t. u. per lb. lime produced.
- h_{gw} = Heat lost in exit kiln gas with wet feed, B t.u. per lb lime produced.
- k = Production coefficient; value depends upon kind of material being processed and other circumstances attending kiln operation.
- k_w = Production coefficient for wet-feed kiln.
- L = Kiln shell length, feet.
- Q_d = Optimum daily output, tons lime produced per day.
- Q_{dd} = Optimum daily output with dry feed, tons lime produced per day.
- Q_{dw} = Optimum daily output with wet feed, tons lime produced per day.
- Q_{hd} = Normal hourly output with dry feed, tons lime produced per hour.
- Q_{hw} = Normal hourly output with wet feed, tons lime produced per hour.
- R_f = Ratio of percent water in feed to percent solids in feed.
- R_k = Ratio of kiln length to kiln diameter, L/D.
- T_c = Temperature at which lime is discharged from system, deg. F.
- T_{gd} = Temperature of gas leaving dry-feed kiln, deg. F.
- T_{gw} = Temperature of gas leaving wet-feed kiln, deg. F.

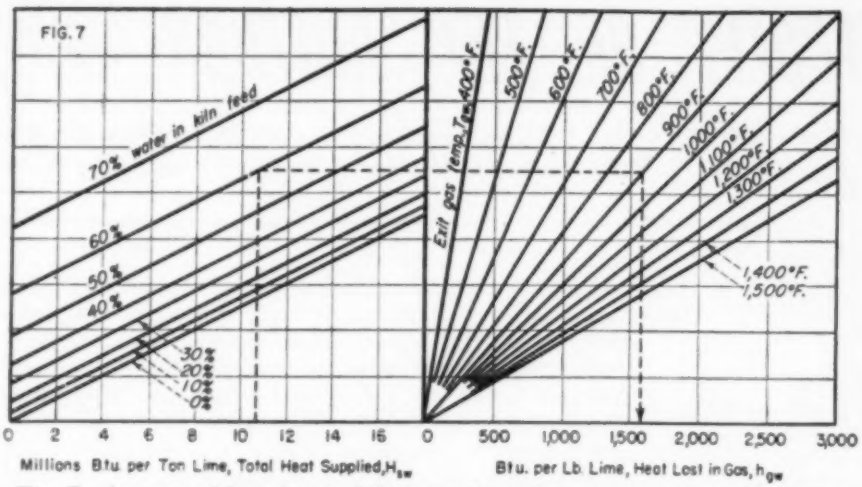


Fig. 7—Amount of heat lost in kiln gases depends on temperature of the gas, percent water in the feed, and the total heat input. See Equation (24)

by the writer are purely empirical, no claims for great accuracy are made for them. On the other hand, the agreement between the practical and the computed results leads to the belief that the computed results will provide at least a practical indication of what can be expected under various conditions.

In the case of the kiln just described, it is possible and certainly practical to incorporate heat exchange devices at both ends of the kiln to improve the thermal efficiency. By the use of such devices, the exit kiln gas temperature can be reduced to 600 deg. F. or even less, and the lime will be discharged from the system at about 400 deg. F. Since a well designed cooler will not have an exchange efficiency much better than 50 percent of the heat available, the value of T_e can be derived by assuming the temperature drop in the cooler is only half of the actual.

Thus, we can better assume the effective temperature of T_e as: $T_e = 2{,}100-(2{,}100-400)/2 = 1{,}250$ deg. F.

The performance of the above kiln under the new conditions will then be approximated by: $k_w = 0.784$ for the high degree of calcination; or, $k = 0.784/0.78 = 1.003$ for 78 percent calcination. The new production rate will be: $Q_{dw} = 49.3$ tons per day. And H_{gw} will be 14.4.

By reducing the moisture content of the feed from 55 per cent to 40 percent: k_w will be 1.075 and k for 78 percent calcination will be 1.38; Q_{dw} will be 67.6; and H_{gw} will be 10.85.

It is predicted by the discussed relations that by reducing the moisture content of the feed to 40 percent instead of 55 percent, and by installing heat exchange equipment, the heat requirement of the system is reduced by some 5,000,000 B.t.u. per ton of lime produced. This is equivalent to about 33.3 gal. of bunker C oil per ton of lime. Furthermore, productivity is increased.

(*Errata:* In the first article in Eq. (10) the figure 3,623 should be 3.623. In the heading of Table II for "Exit Gas" read "Lime Discharged.")

High Test Hydrogen Peroxide*

HYDROGEN PEROXIDE is now available in concentrations up to 90 percent, instead of the previous 35 percent maximum. The higher strength is not just a more compact bleach, but essentially a new chemical of great potentialities in fields ranging from buzz bombs, rockets, and submarines to commercial explosives and synthetic chemicals. It is in effect a new, self-contained source of energy and oxygen which when released leaves no residues or corrosive toxic gases.

To fuel their V-weapons, rocket fighter planes and supersubmarines, the Germans completed or had under construction a twenty-fold increase in hydrogen peroxide capacity, for concentrations above 80 percent. The value of high-test hydrogen peroxide as an energy source lies primarily in the fact that, when proper catalysts are present, it dissociates instantly into five thousand times its volume of steam and oxygen. Official reports indicate that the Germans worked for more than ten years on the development of high-test hydrogen peroxide, but this research, even with strong government support, resulted in a product only 85 percent peroxide and relatively impure.

Stable 90 percent hydrogen peroxide has, however, recently been introduced by a moderate-sized American firm, the Buffalo Electro-Chemical Co., Inc. This product, resulting from a process developed independent of German research, exceeds the standards demanded by but never achieved for the German submarine designers. The American product can be produced in high purity and is said to show practically no loss of hydrogen peroxide content during normal storage over a period of months. Shock, as from a blasting cap, reportedly does not detonate it. It can be shipped and handled in the conventional manner in aluminum drums and tank cars. Spillage should be avoided because contact with combustible matter may cause a fire, though such fires can be easily extinguished with water. Pressure may develop within the container if the solution is allowed to become contaminated.

PACKS A WALLOP

The most spectacular use of high-test hydrogen peroxide is as an energy source to provide, on decomposition, steam and oxygen to drive various types of engines. Close control over the decomposition, permitting a smooth development and maintenance of proper pressures, is obtained by regulating the rate and concentration at which the peroxide is injected into the reaction chamber. Alternatively, the oxygen from peroxide may be used to burn either customary fuels, such as a type of diesel fuel in the Walther engine for submarines, or special chemicals, such as hydrazine hydrate.

As a commercial explosive, high-test hydrogen peroxide is now under test. The ingredients—peroxide and alcohol, for example—may be shipped and stored separately, free from the customary hazards of explosives. When the two are mixed together in proper proportion at the mines, however, they provide an effective explosive which releases no toxic nitrogenous gases.

CHEMIST'S SPRING BOARD

The chemical uses of high-test peroxide are still essentially unexplored. One volume of 90 percent hydrogen peroxide releases an amount of active oxygen which is equivalent to 413 volumes of oxygen gas under standard conditions. This active oxygen is required in many industrial reactions. It leaves no residues, a special advantage for food, drug, and cosmetic applications. It is soluble in many organic materials with which ordinary peroxide does not mix, and may be diluted with organic solvents to slow down reactions. The high-test product is reportedly valuable as a catalyst in the formation of some resins and as a reactant in forming soaplike synthetics.

The price of the hydrogen peroxide contained in the 90 percent solution is only slightly above that of hydrogen peroxide concentrations now common. The producers expect that this increase in cost will be more than offset by the unusual properties of the product, so that a substantial market will be insured. A pilot plant is now operating and a full-scale plant is nearing completion.

* From the Industrial Bulletin of Arthur D. Little, Inc., April 1946.

FROM THE VIEWPOINT OF THE EDITORS——

THE BEGINNING OF REASON

ALWAYS in the back of our minds in these troubled days is the all-important problem of the bomb. Literally hundreds of plans have been proposed for its control, but it remained for the Lilienthal Committee of consultants for the State Department to face squarely both the political and scientific realities of the situation and to come through with a positive and promising solution. This report, you will recall, was the product of many months of intensive study by Dr. J. Robert Oppenheimer, the physicist, Dr. Charles A. Thomas, the chemist, Chester I. Barnard, the businessman, and Harry A. Winne, the engineer, with David Lilienthal of TVA as chairman—all of whom in turn reported to a special policy committee of the State Department under the chairmanship of Dean Acheson.

Their proposal starts out with the very practical assumption that since you cannot outlaw war itself, it is equally futile to believe that any treaty can effectively outlaw the use of atomic energy for either military or peaceful purposes. You have to provide teeth, in the forms of both control and inspection. Neither alone will suffice. In a game of cops and robbers, the cops would be bound to lose. In other words, even double-barreled inspection of both war and peace uses could never be sure of catching up with the criminal. So, simultaneously, there must be control.

Fortunately, uranium and thorium are the only known sources of fissionable materials occurring in nature, and therefore offer the key for getting at this phase of the problem. If we can devise a workable world control or ownership of the sources of these raw materials, there is the best chance that we can effectively curtail or eliminate competition in their use. This would mean the setting up of an agency with universal rights of access in all countries to explore and develop all possible sources of uranium and thorium. The report proposes to put this control in the hands of the Atomic Development Authority, which thus becomes the sole producer of the essential ores. It becomes also the sole producer of U-235 and plutonium by taking over and operating existing plants and building others in various parts of the world. These plants will produce (a) atomic weapons and power, (b) fissionable material in denatured form, (such that it could not be used for military purposes without long and expensive processing in the large plants similar to those required for isotopic separations, yet could be used as atomic fuel in small licensed reactors for industrial or scientific applications) and (c) radioactive byproducts that could be made available freely for medical, industrial and scientific research.

Since the Lilienthal Report was published there has been a lot of foolish talk about denaturing uranium and plutonium, and it is therefore most unfortunate that security restrictions did not permit the authors to elaborate on this phase of their proposal. Subsequently a group of qualified scientists reported that denaturing was never proposed as the complete and foolproof answer to the control problem. Rather, it is important only because it permits a little more latitude in peaceful applications where there is no chance of diversion to large separation plants that would be easily spotted by the inspectors. Any plutonium pile or isotope plant not under ADA license or control would, of course, be subject, if possible, to immediate confiscation.

The whole scheme adds up to a plan that can be made to work if the nations of the world want it to work. To devise an international system that will work in a world that will not cooperate is obviously impossible. But the beauty of the State Department plan is that it begins at the beginning, i.e., with the raw materials, and proceeds stepwise to the more complex and now secret processes of purification and concentration of the fissionable materials. If at any step in the program a nation refuses to cooperate, that refusal at least gives the law-abiding nations of the world a signal that they may have perhaps one or two years in which to prepare for the worst that may come from a race in atomic armament.

America's preeminence does not rest on secrets that can be locked up for eternity. Rather, we have a great resourcefulness in technology and know-how and lead the world in translating the results of laboratory research into the practical production processes such as those at the great plants at Oak Ridge, Hanford and Los Alamos. What we must do now is to become equally resourceful in helping the world to translate the blueprints of the Lilienthal report into a workable organization for international control of atomic energy.

MISSIONARIES FOR MARKET RESEARCH

TIME was, back in the twenties, when chemical market research was a part-time pastime of idle salesmen and overworked laboratory investigators. But five or six years ago, after a couple of faltering starts as an informal discussion group, the Chemical Market Research Association became firmly established and has since grown to respectable status in the chemical industry and profession. Its recent meeting in Detroit drew a large attendance and attracted speakers of national reputation. Earlier in April another quite significant meeting was staged by some of the association's leading members in cooperation with the Junior Chemical Engineers of New York.

Elsewhere in this issue the reader will find an unusually comprehensive report of that meeting with these younger engineers. We are pleased to give it this space and prominence for we feel that the subject matter is worthy of serious study by a much wider audience of technical men and company executives who have not yet come to appreciate so thoroughly the role of market research in the success of the chemical industry. Incidentally, we want to extend our

congratulations to the talented group of speakers who contributed to the program arranged by Dr. William H. Bowman of the Jefferson Chemical Co. This sort of missionary work is true evidence that chemical market research is reaching for professional status. *Chem. & Met.* is proud to have had a part in its progress.

NO SILVER LINING?

MINING interests and congressional representatives, especially senators of western states, have long campaigned for special subsidies for silver. Just now they are in the process of trying to get a still higher price from industrial purchasers of that noble metal.

One or two other groups dealing with other commodities have undertaken similar effort in the past. Just recently one industry managed to build up its costs (and profits) to obtain an OPA ceiling several times the prewar average price for its major product. The result is now proving anything but fortunate for that industry. It has already lost permanently one of its customer groups that formerly used about one-third of the national output of the industry. It is also losing other customer groups rapidly to competitor materials.

We do not see just how all users of silver for industry are going to adopt other competitive materials. Particularly it is difficult to imagine how sensitized photographic film can be made without silver salts. But there are other important uses for silver where there are adequate and satisfactory alternate materials. It will be well if the producers and politicians do not press their efforts too far lest they merely subsidize themselves out of business in these more competitive uses of silver.

EMOTIONAL SCIENTISTS

WHEN is a scientist not a scientist? According to our New York neighbor who writes the "Topics of The Times," it is when he becomes "an angry partisan." The occasion for this observation arose out of the rather violent controversy between the so-called "atomic scientists" and the proponents for military control of atomic energy. The editor held, with some justification it seemed to us, that when the scientists deserted the cold and factual objectivity of the scientific method and substituted the heated and emotional subjectivity of the advocate, they were no longer entitled to be called scientists. Rather, they were just ordinary angry citizens crusading for social, economic and political objectives oftentimes remote from their traditional training and experience. The poor fellow had our sympathy the following week when the full atomic blast of the scientists was turned in his direction. But he held his ground, at the same time applauding the entry of the scientists into the bloody area of politics.

Now comes a dignified editorial in the last *Bulletin* of the American Association for the Advancement of Science on the subject of "Science and Sentimentalism"—not to defend the coldly factual methods of the scientists, but to encourage him to adopt the methods of those "adept at the appeals to the emotions." Citing particularly the leaders of the labor unions and pressure groups for the promotion of this and that in Washington, the editor writes: "Scientists as men of learning should absorb their lessons from the experiences of others, rather than from experiences of their own. The preservation of freedom in research calls for constant vigilance, and much more public education. And it may profitably be remembered that the lay public can more readily be reached through the heart than through the head."

Frankly, we are still confused and quite worried about where all of this is going to lead us. If our scientific friends really become adept at the sentimental sciences and desert their heads for their hearts we can expect almost anything in the way of human transmutations—perhaps creating even politicians, and editors, who will stick to the facts!

FOR A CHEMICAL SAFETY MANUAL

AN ALTOGETHER commendable approach to safety is being made by the Manufacturing Chemists' Association. It is now formulating a series of data sheets for chemical safety, which will make up a manual for producers, handlers and users of important industrial chemicals. These sheets are formulated to give facts. They do not pose a lot of rules and regulations; but they do provide reliable safety information in the most complete and usable form.

Every user of chemicals and all agencies which deal in packaging and transportation of these materials are encouraged by MCA to get and use these "Chemical Safety Data Sheets.'" Everyone can gain from a careful study of them, as they give all of the essential physical and chemical properties which may contribute either to personal hazard or to the possibility of fire or explosion.

LONG-RANGE SOLUTION

WHEN Dr. Livingston W. Houston was recently inaugurated as president of Rensselaer Polytechnic Institute he willingly accepted the college's responsibility for doing what it can to relieve the nation's shortage of scientists and engineers, which he estimated will reach 150,000 by 1950. This shortage, he said, is a result of this country's training program being thrown badly out of balance during the war. "As a national policy." he insisted, "we should not permit this situation to exist a day longer than is necessary, particularly when other great countries have maintained at normal level, or even increased, their numbers of technological personnel.

"We are also preparing for what we believe will be a permanent expansion in engineering education. A recent survey shows that 25 leading colleges and universities plan to spend an average of about two million dollars each in buildings, laboratories and equipment. RPI's present program calls for more than double that average. Sweeping advances in science and engineering require tremendous amounts of new equipment and new buildings to house that equipment."

Discussing what in his opinion was the chief function of education, particularly in science and engineering, President Houston said: "This present period, of months or perhaps years, is only a breathing spell while the world makes up its mind which way to turn. . . . The solution, both with regard to world conflicts and those now existing among groups in our own country, lies mostly in education, if anywhere; not through formal education alone, but through all means that can be employed to create enlightenment and goodwill among individuals and nations."

Future Outlook for Plastic Materials Supply Situation

W. STUART LANDES *

Vice President, Celanese Corp. of America

FROM the standpoint of the suppliers of plastic materials the problems today are more difficult than at any time during the war. Although we are working our plants at maximum capacity wherever we can obtain sufficient raw materials ourselves, the demand for most of our products exceeds the supply by an average of 3 to 1. Total output of plastics today is running almost 2 to 1 compared to 1944 and the shipments of all types of molding materials are running 5 to 3 compared with 1941.

THREE REASONS

Practically everything is now very short of the demand and there are three fundamental reasons. (1) There is a world shortage of civilian goods caused by several years of war and the accumulated pent-up demand for those things that were not produced during the war. (2) Most of the former industrial centers of the world, except the United States, are dried up either as war casualties or because of lack of essential raw materials. The only possible exception to this is in Silesia, which is behind the iron curtain of Russia and which might as well be out of the picture. (3) In the United States, at least, consumer demand has been further stimulated by high wages and accumulated savings.

In the plastics industry there are further influences at work. People have been made so aware of plastics from the man in the street to the industrial designer that they are naturally turning more and more to plastics, not only because of their actual merit, but to relieve shortages of other materials.

How did the molding and fabricating capacity get so far out of balance with the material supply? Assume that these two factors were in equilibrium in 1941. Prior to that time it is doubtful if the molding industry ever operated at capacity, except for short peak periods with long intervals between. During the war this capacity was greatly increased and today is being enlarged at an even greater rate. It was possible for any molder to obtain additional equipment if he was willing to take on war business.

On the other hand, the material producers were denied the privilege of expanding plant capacity during the war except in a few cases. Some of the newer plastics were expanded where they were required for a decidedly important war use in value, but generally speaking, the rule was that as long as a manufacturer's capacity was sufficient to take care of the demand for war purposes, no priorities for expansion would be granted. Very little basic increases in plant capacity have been realized as yet since V-J Day.

In addition to the fact that we have more injection machines with larger average capacity, they are more efficient machines. Another reason why consumption has increased is that the average order received by a molder today is much larger than it was in 1941 and he can, therefore, realize longer runs with less time out for changing molds and materials. Last but not least, most plastic materials today are better and more uniform than they were prewar. These factors taken in the aggregate have increased the potential capacity by at least 25 percent.

Another factor has very definitely increased the demand on the part of the molders. Average hours of operation have probably increased 50 percent. The extrusion demand has been growing apace. Roughly speaking, the number of extruders in operation in the past and planned for the future is about one-third the number of injection machines. Approximately half the plastic type extruders are running on vinyl materials and they must be excluded from this comparison because vinyl materials are not included in the molding powder production figures. Extruders generally operate 24 hours a day as compared to a 16-hour schedule for injection machines. The average extruder will consume three times as much material as the average injection machine. Therefore, to calculate the potential capacity for molding powder as related to the injection molding capacity, start with one-third of the number of machines and take 50 percent of this total. Multiplying by three times for the machine capacity and by 1.5 for the additional hours gives a factor of 75 percent. In other words, the extrusion demand alone amounts to three-quarters of the injection molding demand.

Consider the available supply of thermoplastic molding material. If we take 1939 as 100 percent, by 1941 the production has reached approximately 300 percent. Today at the end of the first quarter of 1946, it is approximately 750 percent. The ratio is 2.5 to 1 compared to 1941. By 1947 we expect it to reach 1,739 percent which will be 2.3 times the current rate of production. In spite of these increases the supply today is totally inadequate. We will have the same situation next year.

The material suppliers report a current demand ratio of 3 to 1, and it might be assumed that approximately one-sixth of this is duplication or inflation. The same condition, although to a lesser degree, is true also in compression molding.

Film is just as critical as molding material. Apparent demand exceeds production by even 4 to 1 in some cases. Sheets, rods and tubes, with the exception of vinyl butyral, are bad enough with the demand running 2 to 1. The only forms where the supply is at all adequate are adhesives and some types of laminating varnishes. Lack of flexibility in producing equipment makes it impossible to switch production to any extent from one form to another. The production of adhesives has been cut temporarily in some instances to divert the raw material to molding powder.

Plastic materials today represent so large a percentage of the chemical industry that any sizable expansion on our part requires expansion in the production of such chemicals as phenol, formaldehyde, urea, acetylene and acetic and other acids, benzol, chlorine, bleached alpha cellulose, and similar materials.

MOLDING MATERIALS

Turning to three of the principal molding materials,—phenolic, urea melmine and cellulosic—these are expressed in percentages with the year 1939 as 100. Today cellulosic molding material is running in excess of 500 percent and the other two in the neighborhood of 300 percent. The 1946 production of cellulosic will be nearly 600 percent and the other two 250 percent. By 1947 cellulosic material will be available at the rate of 800 percent, urea melamine at nearly 350 percent and phenolics at the rate of nearly 300 percent. Or, in terms of current rate of production, by some time next year we should see cellulosics up 60 percent, urea melamine up 75 percent and phenolics up 50 percent.

It is well nigh impossible to represent polystyrene on a graph without using logarithm tables. Again taking 1939 as 100 percent, the 1945 production was over 32 times as great. By the middle of 1946 the output will be again doubled, and by 1947 it is anticipated to be six times as great as in 1945.

In the acrylics, plans for the future are less concrete. The 1945 production was almost 50 percent greater than 1944 and the 1946 estimated production will be over twice as great as 1945. The producers of acrylic molding materials wish to assure the trade that there will be ample supplies to take care of the demand.

Where will the industry be ten years from now? Such an eminent authority as Dr. Gaston Dubois of Monsanto has predicted that it will double itself every five years for the next ten.

We should reach a capacity of 3.6 billion pounds by 1955. At any rate we shall soon be talking production statistics in tons rather than in pounds.

*Digest from an address before the 1946 conference of the Society of the Plastics Industry, New York, April 23, 1946. Mr. Landes is also president of the Plastic Materials Manufacturers Association.

CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chem. & Met.* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the *"Chem. & Met. Plant Notebook."* The winner each month will be announced in the issue of the next month: e.g., the May winner will be announced in June, and his article published in July. Judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest will be published if acceptable, in that case being paid for at space rates applying to this department. (Right is reserved, however, to make no award in months when no article received is of award status.)

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

APRIL WINNER!

A prize of $50 in cash will be issued to

A. E. Kroll and P. G. Foust, Jr.
Lehigh University
Bethlehem, Pa.

For an article dealing with a method of continuous measurement of the moisture content of gases that has been judged the winner of our April contest.

This article will appear in our June issue. Watch for it!

March Contest Prize Winner

A SELF-CLEANING ORIFICE FOR LIMITING PIPE FLOW MADE FROM A COMMON PLUG COCK

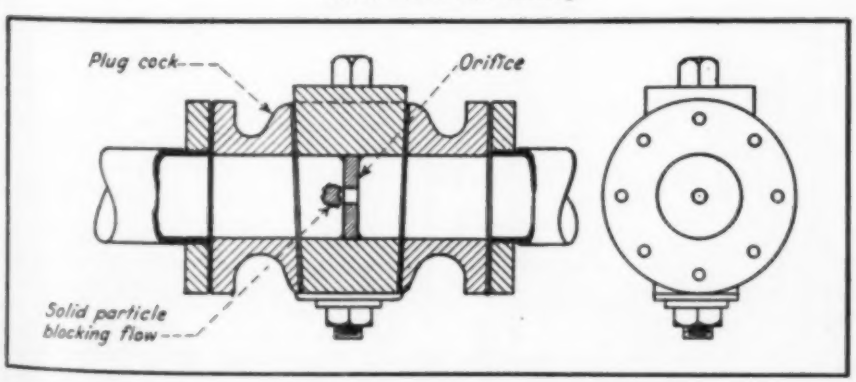
A. C. GUILLEN
Engineer
Algiers, North Africa

It is often desirable to install an orifice in a pipeline in order to limit the flow in the pipe. However, if solids are present in suspension in the liquid, there is always danger of the solids building up against the orifice plate and either changing its characteristics or blocking it entirely. Ordinarily the only remedy is to shut down the line and remove the orifice for cleaning, which is not only troublesome but time consuming.

A very simple solution to this problem is to weld the orifice plate into the opening in the plug of an ordinary plug cock, as shown below in the drawing. If the plug carries a projection to limit it to a quarter turn, it is necessary to remove the projection so that the plug can be turned through 180 deg. In use, when an obstruction builds up, it is only necessary for the operator to turn the plug through 180 deg. so that the pressure of the liquid can carry off the accumulated solids. With proper calibration the same device can probably be used for metering.

DON'T FORGET
the new rules for the Plant Notebook Contest

Building an orifice into a common plug cock is a means of making a flow limiting device that is self-cleaning



PROTECTING KARBATE TUBES IN AN HCl ABSORBER

LUKE J. GOVERNALE
Chemical Engineer, Ethyl Corp.
Baton Rouge, La.

KARBATE cooling tubes in a hydrogen chloride absorber are cooled with circulating water taken off a header with a normal pressure of 80 lb. ga. (maximum of 100 lb.) and returned to a header operating at 20 to 40 lb. ga. pressure. The Karbate cooling tubes are designed for a maximum operating pressure of 52 lb. and special design was required to protect these tubes and critical equipment from excessive pressure which could be brought about by the high inlet header pressure.

In addition to the usual pressure controller a safety valve following this instrument was considered in the event the controller did not act fast enough. However, a safety valve of enormous size or at least several safety valves would be required under this set-up to reduce water pressure under the worst possible conditions from a maximum supply of 100 lb. ga. to a Karbate header pressure of 52 lb. ga. A limiting orifice was, therefore, installed on the inlet water line upstream from the safety valve and pressure controller and was designed to permit maximum cooling water requirements under minimum possible pressure differential ($80 - 40 = 40$). A safety valve of practical size was then designed to take care of the water flow under its maximum pressure differential ($100 - 52 = 48$).

As the point of protection was approxi-

mately 20 ft. above ground grade and the safety valve would discharge to the sewer, additional safety valve capacity was realized by locating the safety valve at ground grade, in that its set pressure could be increased from 52 to 52 + 20/2.31, or approximately 60 lb.

CHART FOR FLOW OF SATURATED AND SUPERHEATED STEAM

DALE S. DAVIS
Wyandotte Chemicals Corp.
Wyandotte, Mich.

IN CONNECTION with the flow of saturated and superheated steam through a sharp-edged orifice, Dalton[1] presented two plots for use with the equation

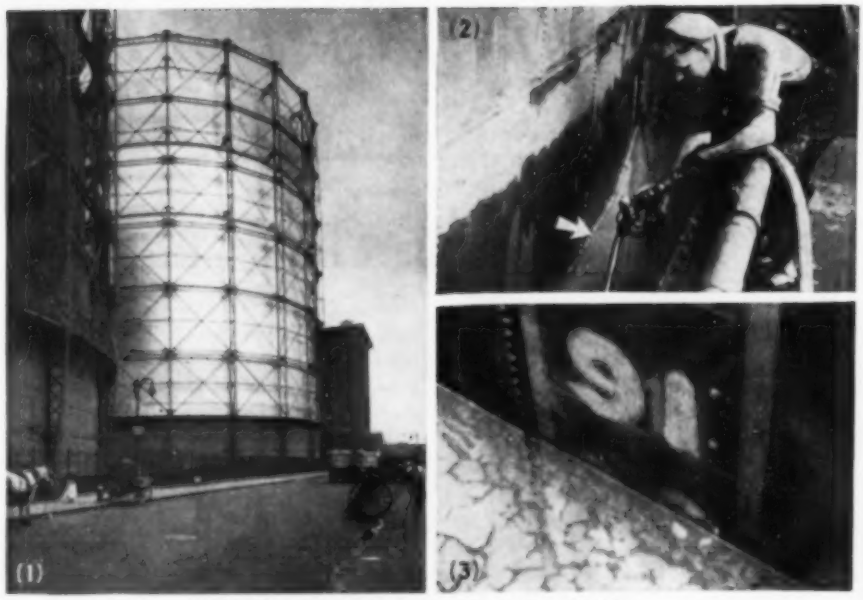
$$d = \beta B \sqrt{w}$$

where d = the diameter of the orifice in inches; w = the rate of steam flow in pounds per hour; $\beta = (v/P)^{0.25}$ and $(v/p)^{0.25}$ in which v is the specific volume in cubic feet per pound and P and p are the initial absolute pressures, in pounds per square inch, of saturated and superheated steam, respectively. The term B is defined by:

$$B = \sqrt{\frac{(4/\pi)\ (1/0.60)}{300\left[\frac{2\,g\,k}{k-1}\left(r^{\frac{2}{k}} - r^{\frac{k+1}{k}}\right)\right]^{0.5}}}$$

in which r is the ratio of the final and initial absolute pressures; k is the ratio of the specific heat at constant pressure to that at constant volume; g is the acceleration due to gravity, 32.2 feet per second per second; and 0.60 is the orifice coefficient.

The flow equation can be solved without recourse to supplementary plots by means of the accompanying alignment chart, constructed by methods described previously[2]. Actual values of β and B are not needed and do not appear on the nomograph. For superheated steam, values of v and p must be used to locate a point on the β axis; for saturated steam the P scale, on the β axis, determines values of β in an implicit manner. For superheated steam, in the pressure range of the chart, $k = 1.30$ and $B = 0.02058 \div (r^{1.5385} - r^{1.7692})$. For saturated steam, $k = 1.13$ and $B = 0.01729 \div (r^{1.7699} - r^{1.8850})$. Below $r = 0.97$ the two expressions yield values of B which agree within a few tenths of one percent so that a single r scale is sufficient. The point $r = 0.55$ is used for all values that are less than this critical ratio.



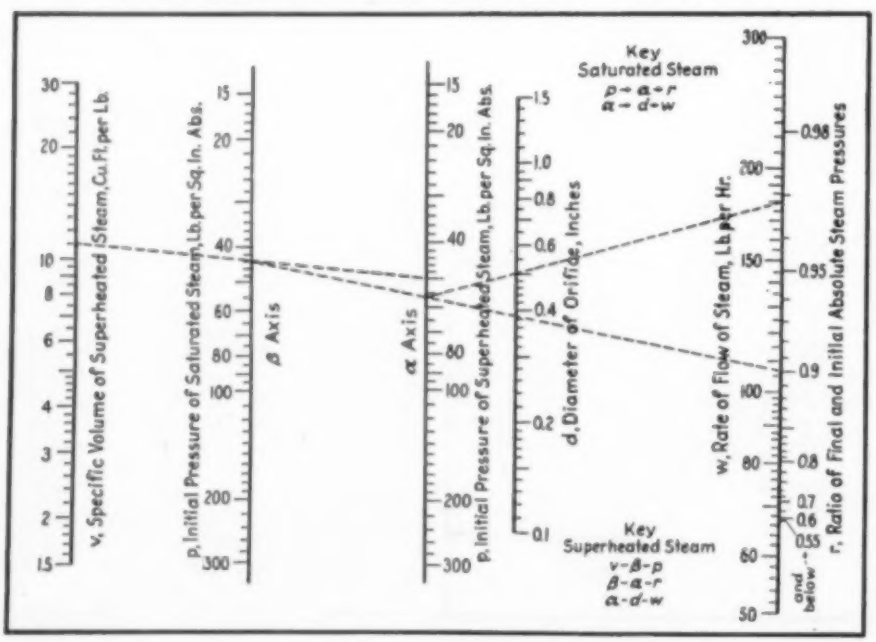
Quick Paint Job for a Huge Gas Holder

Water sealed gas holders can be painted in a minimum of time with little labor and at substantial savings in cost by a new process developed by L. B. Donovan, assistant general superintendent of the holder maintenance and painting bureau of Consolidated Edison Co., New York. Although the process has been patented, its benefits will be made available free of charge to the utility industry upon application to the Consolidated company.

In the new process the paint is floated on to the holder surfaces by using a layer of a special aluminum paint on the water in the holder cups. Thousands of square yards can be painted as quickly as the lifts can be submerged and then raised again. Air bubbles and half painted rivets are avoided, together with other mechanical causes of paint failure, the skill and good right arm of the master painter being supplanted by the laws of hydraulics. Less than half of the holder, comprising the guide frames and other parts that cannot be submerged, must be painted by hand.

Paint of controlled viscosity and gravity must be used. More is floated on to the water surface than is actually used, the rest being reclaimed. Paint comes to the job in a tank truck and is pumped into the holder cups to a depth of 1 to 4 in. Fig. 2 shows the paint flowing in, and Fig. 3 the paint layer on the water surface. After use the surplus is drawn back to the tank truck through a suction hose where it is checked for characteristics, and the small amount of water is separated.

This nomograph correlates orifice diameter and flow rate for steam



The use of the nomograph is illustrated as follows. What is the diameter of a sharp-edged orifice through which 180 lb. of superheated steam at 480 deg. F. pass in one hour with a 5-lb. pressure drop when the initial absolute pressure is 50 lb. per sq.in.? From the steam tables it is found that the specific volume of 50-lb. steam superheated to 480 deg. F. is 11.06 cu.ft. per pound. The final and initial steam pressures are 45 and 50 lb. per sq.in. abs., respectively, and their ratio is 0.90. Following the key and the index lines, connect 11.06 on the v scale with 50 on the p scale and note the intersection with the β axis. Connect this point with 0.90 on the r scale and note the intersection with the α axis. Connect this point with 180 on the w scale and read the diameter of the orifice on the d scale as 0.50 in.

What diameter of orifice would be required for saturated steam of the same initial and final pressures? Connect 50 on the P scale (β axis) with 0.90 on the r scale and note the intersection with the α axis. Connect this point with 180 on the w scale and read the diameter of the orifice on the d

scale as 0.47 in. Index lines for this illustration are not shown on the chart.

The nomograph can also be used to calculate the rate of flow of steam when the diameter of the orifice is known.

REFERENCES

1. Dalton, T. N., *Chem. & Met.*, Mar. 1945, p. 117.
2. Davis, D. S., "Empirical Equations and Nomography," Chap. V, McGraw-Hill Book Co., New York, 1943.

CRITICAL TEMPERATURE FROM NORMAL BOILING POINT

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Department of Chemical Engineering
New York University
New York 53, N. Y.

A NOMOGRAPH and three scales presented here correlate normal boiling points and critical temperatures for all substances according to the Meissner and Redding equations as follows:

For compounds for which $T_b < 235$ deg. K., and also for all elements, Fig. 1 applies. The equation is:

$$T_c = 1.70\,T_b - 2 \qquad (1)$$

where T_c = critical temperature, deg. K., and T_b = normal boiling point, deg. K.

For compounds for which $T_b > 235$ deg. K., if they contain halogens or sulphur, Fig. 2 applies. The equation is:

$$T_c = 1.41\,T_b + 66 - 11\,F \qquad (2)$$

where F = number of fluorine atoms.

For compounds containing no halogens or sulphur, but where $T_b > 235$ deg. K., Fig. 3 applies for aromatics and naphthenes. The equation is:

$$T_c = 1.41\,T_b + 66 - r\,(0.383\,T_b - 93) \qquad (3)$$

where r = ratio of non-cyclic carbon atoms to total carbon atoms.

For all other compounds, where $T_b > 235$ deg. K., Fig. 4 applies. The equation is:

$$T_c = 1.027\,T_b + 159 \qquad (4)$$

These equations yield critical values usually within 5 percent of experimental results when $T_b < 600$ deg. K., except for water. In the case of non-polar or slightly polar compounds for which the liquid density at the normal boiling point is known the Watson equation may give better results.

REFERENCES

Meissner, H. P., and Redding, E. M., *Ind. Eng. Chem.*, 34, 521 (1942).
Hooks, I. J., and Kerze, F. Jr., *Chem. & Met.*, June, 1945, p. 116.

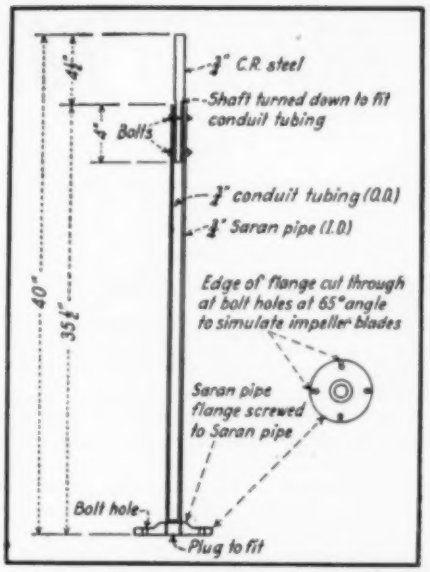
SARAN AGITATOR FOR A 65-GAL. VESSEL

ALBERT STEIN
Schering Corp.,
Union, N. J.

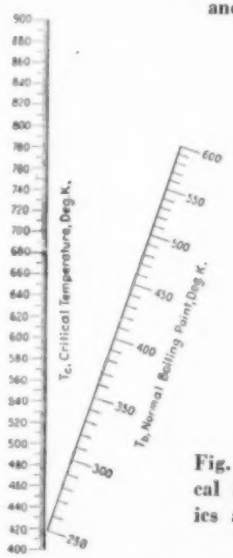
IT IS well known that Saran has excellent corrosion resistant properties. However, under certain conditions it can be broken. It was found desirable to construct a turbine-type agitator out of Saran which would handle a very heavy iodine slurry as it dissolved in potassium iodide solution. A number of designs were tried but the one shown in the accompanying sketch seemed best.

A piece of ¾-in. electrical conduit tubing has the proper outside diameter to fit into standard ¾-in. Saran pipe as a stiffener. The lower end of the Saran pipe is threaded and a standard ¾-in. Saran flange is screwed on. The opening in the bottom of the flange is plugged with a Saran plug.

The bolt holes are cut through the periphery of the flange at a pitch of about 65 deg. which simulates the action of a turbine blade. The upper end of the ¾-in. electrical conduit is adapted by means of a steel shaft to fit the chuck of the agitator motor. Excellent agitation can be obtained with this agitator running at 1,700 r.p.m. in a 65-gal. vessel.



Saran agitator with strengthened shaft and flange formed into a turbine



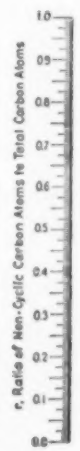
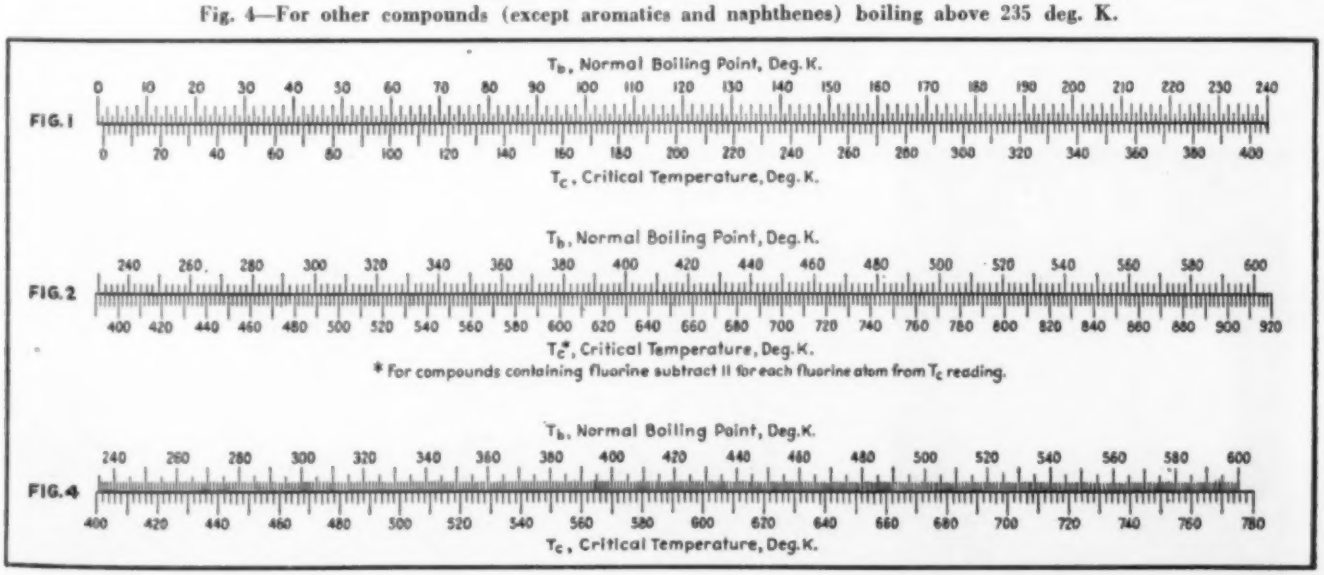


Fig. 3—Nomograph for critical temperatures of aromatics and naphthenes boiling above 235 deg. K.

Fig. 1—For elements and compounds boiling below 235 deg. K.

Fig. 2—For halogen and sulphur containing compounds boiling above 235 deg. K.

Fig. 4—For other compounds (except aromatics and naphthenes) boiling above 235 deg. K.



PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

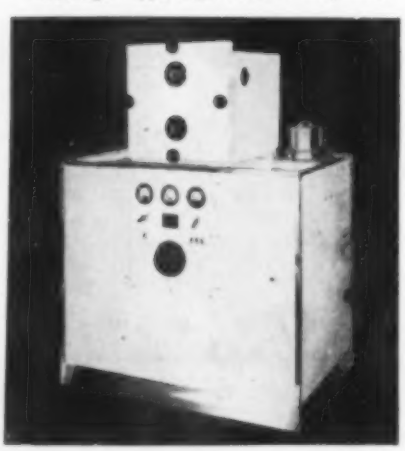
HIGH VACUUM EQUIPMENT

SEVERAL developments in equipment for use and measurement of high vacuum have been announced by National Research Corp., 100 Brookline Ave., Boston, Mass. Among these is the new Type 3501 dehydration unit designed for laboratory and pilot plant production. This "packaged" unit includes all equipment necessary for the desiccation or concentration of heat-sensitive biologicals, anti-biotics, fine chemicals and the like. It consists of a pumping system with a 2-in. oil diffusion pump, backed up by a 12.5 c.f.m. mechanical pump which is also used for roughing. A cold trap with a capacity of 4 lb. of ice is provided, together with three thermocouple gages and provision for four thermocouples in the cabinet to permit control of heat input. The drying cabinet itself is 16x16x24 in., equipped with three adjustable shelves which are electrically heated with a controllable input of 1 kw.

New high vacuum measuring devices include the Type 507 ionization gage and the Type 706 thermocouple-ionization gage control. The first of these is a rugged industrial instrument of high sensitivity which is said to achieve stable operation under varying pressures in the range from 0.001 to 1 micron. The Type 706 gage combines this company's Type E thermocouple gage with any standard ionization gage. The thermocouple gage handles pressures from 1 to 1,000 microns and the ionization gage from 0.0002 to 5 microns. Features include a tested thermocouple gage circuit and an ionization gage circuit with outgassing provision, interlocking relay for protection, zero set and zero adjust controls for amplifier balancing.

This company has also introduced the Model H-10 diffusion pump, an all metal 10-in. pump with a capacity of 3,000 c.f.m. from 2 to 0.01 microns. Extra heavy construction, large capacity and low cost are features of this oil-operated high vacuum exhauster.

"Package" type high vacuum dehydrator



AIR WHEEL TRUCK

HANDLING of loads up to 500 lb., over rough floors and even up and down steps and curbs, is facilitated by the new pneumatic-tired hand truck, known as the Plate Nose model which has recently been added to the line made by Rapids-Standard Co., 108 Peoples National Bank Building, Grand Rapids 2, Mich. Of arc welded construction, the truck has a solid nose to enable it to handle cases, kegs and bags with greater facility. Anti-friction bearings with provision for effective lubrication add to the ease with which the truck can be handled.

Pneumatic tired hand truck

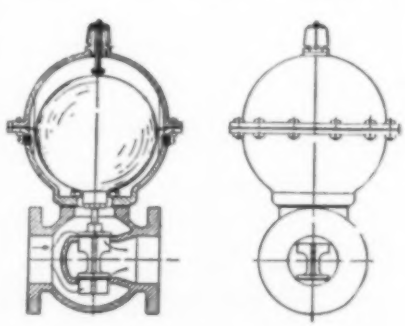
RUSTPROOF CONVEYOR

A PORTABLE conveyor of a new rustproof, dustproof design has been added to the regular line of E. W. Buschman Co., Cincinnati 32, Ohio. The wheel treads and hubs of the skate-type wheels used are protected with a heavy zinc plate. A special inner seal excludes water, dust, grit and other harmful foreign substances from the ball bearings, insuring smooth operation and long life. Similar in dimensions to the company's standard line and interchangeable with it, the new conveyor is available in 10 ft. and 5 ft. lengths as well as 90, 60, 45 and 30 degree curves.

AUTOMATIC VALVE

A NEW TYPE of valve known as the Davis Air-Lok has been developed by Davis Regulator Co., 2539 South Washtenaw, Chicago, Ill. Designed primarily for use in gathering lines connected to oil field lease tanks, these valves would appear also to be useful in other cases where a single pump draws liquid from several storage tanks. The primary function of the valve is automatically to close the line in which it is installed as soon as liquid has been withdrawn from that particular tank before air or vapor can be pumped into the system. As shown in the accompanying illustration, the device consists of a spherical float connected to a balanced double-disk valve. When liquid is available in the gathering line the liquid level rises in the float chamber causing the valve to open. Two sizes at present produced have flanged connections for 3- or 4-in. lines. Other uses suggested for the valve include draining of condensate from multiple-effect evaporators, gas-liquid accumulating tanks and steam condensate flash tanks. The present design is recommended for pressures up to 150 lb. at temperatures to 250 deg. F.

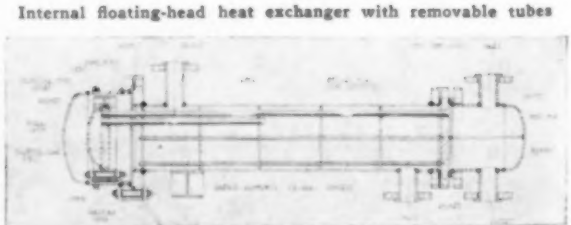
Right—Gathering-line valve



STAINLESS EXCHANGER

WHAT IS perhaps the most complete line available of standard stainless steel heat exchangers and condensers is the series announced recently by the Pfaudler Co., Rochester 4, N. Y. These units include four fundamental types, one having fixed tube sheets and a non-removable tube bundle, and three types having removable tube bundles. Of the latter, one has a packed floating head, another an internal floating head. The last is a hairpin-tube type with a removable tube bundle. A broad range of lengths and capacities is available, with tube lengths in 1 ft. increments up to 16 ft. or longer, and tube surface areas from 5 to over 1,000 sq. ft. in a single tube bundle. Standard design pressures are full vacuum, 75 lb., and 150

Internal floating-head heat exchanger with removable tubes

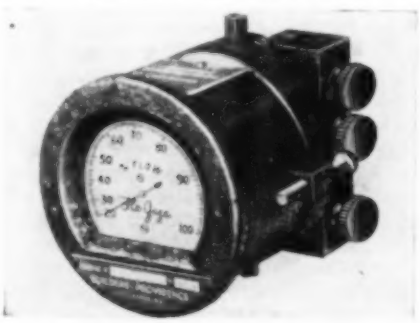


lb. Shell diameters range from 4 to 24 in. nominal size. Tube sizes include ⅝, ¾ and 1 in. O.D., with passes on the tube side from one to eight. Various tube and baffle arrangements can be secured, as well as various nozzle locations. Several combinations of construction materials may be had, for example, all stainless steel, or stainless steel tubes, tube sheets and bonnets, with remaining parts of carbon steel. Non-ferrous alloys can also be used for tubes, tube sheets and other parts.

FLOW GAGE

FOR APPLICATIONS where a midget differential meter suffices for indicating the rate of flow of liquids or gases through lines containing orifices, venturi tubes or flow nozzles as differential producers, a simple, inexpensive flow indicator known as the Flo-Gage has been introduced by Builders-Providence, Inc., 29 Codding St., Providence, R. I. The gage has no stuffing box and is claimed to indicate rate of flow within 2 percent of full scale. The gage mechanism is inclosed in a heavy semi-steel chamber having a fixed, pre-stressed glass window for operating at pressures up to 500 lb. The chamber is filled with a neutral transparent fluid which transmits pressure from the low pressure line to the outside of the standard pressure gage unit. Pressure from the high pressure line is communicated to the inside of the gage bellows. The gage thus registers the differential between inside and outside bellows pressures. It is suitable for the metering of water, steam and air as well as many other fluids.

Differential flow meter gage



Automatic variable delivery pump

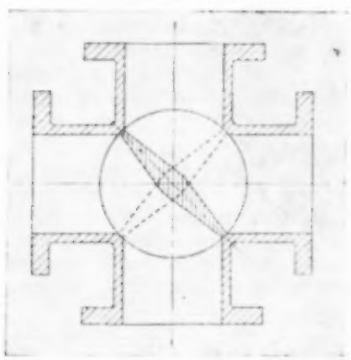
VARIABLE STROKE PUMP

STEPLESS capacity variation from 0 to 100 percent is secured by means of simple and compact mechanism in the Automatic Vari-flo variable-stroke triplex pump now produced by Worthington Pump & Machinery Corp., Harrison, N. J. The 75 hp. model illustrated is provided with an hydraulic control cylinder at the left for automatically varying the stroke and hence the delivery. An important feature of the design is the provision of stuffing boxes on top of the cylinders so arranged that they can readily be packed and adjusted, while the location prevents any possibility of stuffing box leakage finding its way into the crankcase. The complete variable stroke mechanism is self contained in the crank shaft, functioning on a simple principle of varying the position of an eccentric to suit the desired stroke or pumping capacity. The pump is suitable for many high pressure services including hydraulic extrusion presses and product charging in chemical plants and refineries. Automatic controls for such services are available.

POSITION INDICATOR

FOR USE wherever remote indication and control systems are employed, the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has introduced d.c. remote position indicating equipment which can be operated from any a.c. or d.c. line. In addition to its use in remote control of multiple synchronized diesel-electric drives, the device is suggested for remote indication or control of level, pressure and flow. It employs a receiver and a transmitter and is claimed to give immediate receiver response without hunting or over-shooting over the entire operating range of the system. The receiver is a positioning unit in which the relative strength of the magnetic fields of the stator determines the position that its permanent magnet rotor will assume. Any change in this relationship causes the rotor to turn and to assume the position corresponding to that of the transmitter. The transmitter is essentially a variable resistance bridge operated manually or automatically, which controls the relative strength of the two magnetic fields of the receiver. Receiver and transmitter torques are independent, the receiver torque having no reciprocal action on the transmitter. A single transmitter can operate any number of receivers within rated capacity. Six sizes now available range from 6 oz.-in. to 360 lb.-in. approximate pullout torque.

Cross section of four-way transfer valve



Hydraulic pressure unit

TRANSFER VALVE

THIS COMPANY'S "A" Metal, a tough, dense metal of uniform grain and high endurance limit, is used in the new 125 lb. single-vane, quick-operating, four-way transfer valve recently announced by R-S Products Corp., Wayne Junction, Philadelphia 44, Pa. The valve is designed to transfer chemicals, oil, paper pulp, water and other materials from one line to another, either manually or under automatic operation. Types are available for a wide range in pressure and in sizes from 4 to 72 in. Valves of similar design can also be fabricated in other metals to meet individual requirements.

HYDRAULIC UNIT

DEVELOPED for hydraulic power take-off on tractors, and now available for a variety of industrial uses, is the Roper-Pac, a hydraulic power unit introduced by Geo. D. Roper Corp., Rockford, Ill. The device is not much larger than an automobile storage battery and includes within one casing the rotary gear pump, control valves and a 2-gal. oil reservoir. The shaft can be connected to an electric motor or gasoline engine to drive the pump. The pump delivery is connected by means of a pipe to a hydraulic cylinder which is moved by

New Stress-Relieving Furnace

One of the largest installations of its type in the country, this new stress-relieving furnace of Chicago Bridge & Iron Co., Chicago, Ill., is the largest of three furnaces to be constructed for this company by Rust Furnace Co. of Pittsburgh. The furnace is 85 ft. long, 15 ft. 2 in. wide and 16 ft. high from car floor to spring of arch. Two other smaller furnaces are being constructed at the company's Greenville, Pa., and Birmingham, Ala., plants.

pump pressure to lift a load or perform other useful work. A control shaft extending from the casing determines by its position what portion of the stroke cycle will be accomplished. For example, the load may be raised, held in the raised position, lowered, or the device reset for the next cycle. Pump delivery is 6 g.p.m. at 500 r.p.m. or 13 g.p.m. at 1,000 r.p.m. for 400 lb per sq. in. pressure Delivery decreases slightly for higher delivery pressures. Normal operating pressure is 800 lb. per sq. in. while momentary loads of 1,200 lb. per sq. in. can be handled.

JET PUMP

WIDELY USED on shipboard by the Navy and Merchant Marine, a line of portable eductors manufactured by Schutte & Koerting Co., 12th and Thompson Sts., Philadelphia, Pa., is now available for industrial purposes. These jet pumps are of simple, sturdy construction without moving parts and can be made of a variety of materials including plastics to enable them to fit the needs of special processes or conditions. A high velocity pressure jet entrains the secondary liquid to be moved and converts the kinetic energy of the pressure liquid into static head capable of lifting water up to 75 ft. The pressure water may be obtained from water mains, pumps or similar sources. Such eductors require no foundations and hose can easily be coupled on, permitting uses in a variety of applications where other types of pumping equipment are not suitable owing to inaccessibility, cramped space, or the time involved in setting up.

Portable jet pump or eductor

Surface pyrometer with interchangeable thermocouples

IMPROVED PYROMETERS

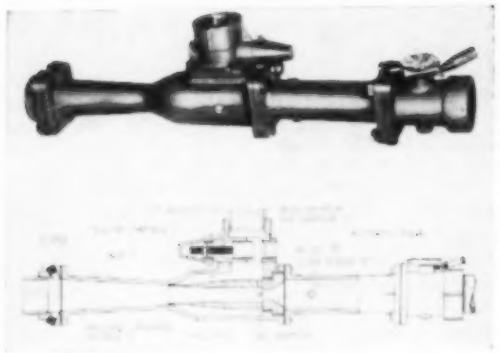
TWO NEW pyrometers have recently been announced by the Pyrometer Instrument Co., 103 Lafayette St., New York 13, N. Y. Illustrated herewith is a new surface pyrometer which permits a selection of eight different types of thermocouple, instantly interchangeable without adjustment or recalibration, which can be adapted to any sort of surface temperature problem. Two types of extension arm are available, as well as five different temperature ranges from 0-300 deg. F. to 0-1,200 deg. F. An internal automatic cold junction compensator is standard equipment.

Another new instrument is an immersion pyrometer for temperature ranges of 0-1,500 deg. F. and 0-2,500 deg. F. Two models in over-all lengths of 27 and 43 in. are manufactured, both having a specially designed swivel 8 in. from the connector block which permits the use of the pyrometer at any angle. Either bare metal or protected type thermocouples can be used, both being instantly interchangeable.

GAS-AIR MIXER

INDUSTRIAL gas burning equipment can be provided effectively with gas-air mixtures, according to the manufacturer, through use of the new Flomixer recently developed by the Industrial Division of Bryant Heater Co., Cleveland, Ohio. The device utilizes the energy of a stream of air at pressures up to 3 lb. to entrain a combustible gas and deliver the mixture at unusually high pressures to the burners it supplies. It is available in pipe sizes ¾ to 4 in., its claimed high efficiency being due, it is said, to careful internal design which results in reduction in pressure losses. This enables air requirements to be lessened in producing a given mixture pressure and smaller blowers to be used. An air supply of 1 lb. pressure is claimed to produce a mixture pressure of 13 in. water column with natural gas, 11½ in. with manufactured gas.

It is claimed that accurate air-gas proportions are maintained at all rates of flow as long as zero pressure gas is supplied and that the entire combustion system therefore has a wider range of operation without requiring higher initial air pressure or ultra-sensitivity of adjustment. The device is said to be suitable for any kind of gas from 550 to 3,200 B.t.u. with no change of equipment necessary in case of changeover. Construction is indicated in an accompanying view.



Cross section of gas-air mixer

Improved platform dial scale

IMPROVED DIAL SCALE

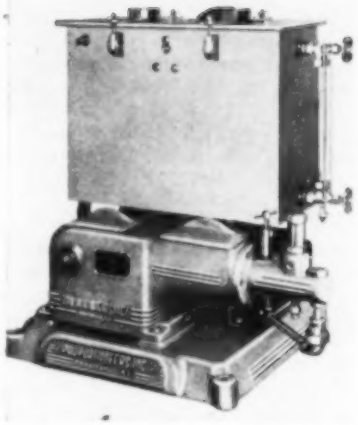
NUMEROUS improvements in design have been effected in the new portable dial scale announced by Howe Scale Co., Rutland, Vt. The scale is light in weight, net weight of the tare beam model being 375 lb. Equipped with the company's newly designed tape drive and ball bearing mechanism, the scale has no pinion, rack or sector and no lost motion or back-lash. Its mechanism is self-compensating for temperature changes and it is claimed that only immeasurable wear occurs on any of the working parts. The tare and capacity beams are fully inclosed, the inclosing box being provided with a cover if specified. The platform is of the free-oscillating three-lever type, the levers operating on fixed fulcrums and being extremely heavy and well seasoned. The wheels are beneath the platform shell, out of sight, and the platform design is such that loads can be placed on the extreme edges.

ROTATING WATER JOINT

SIZES from ¼ in. pipe size up to 6 in. are available in the new Deublin Union, a new type of rotating water joint announced by the Deublin Co., Northbrook, Ill. This joint is suitable for cooling revolving shafts, cylinders or drums, and can also handle liquids for heating up to 200 deg. F. The rotor is machined of stainless steel which has over three times the tensile strength of cast shafts. The housing is of bronze. A standard, steel ball bearing provides almost frictionless freedom of movement. A helical groove on the rotor, which runs counter to the direction of rotation, prevents leakage between the shaft and housing, owing to the sweeping action of the helix. This union is made in two types known as the Monoflow and the Duoflow.

LOW-RANGE GAGE

FOR USE in gas plants and similar applications, in the indication of low pressures of gases or liquids that are not corrosive to bronze, Manning, Maxwell & Moore, Bridgeport, Conn., has developed a new bellows type low-pressure gage employing a self-draining bronze bellows with a phosphor bronze calibration spring. Adjustable stops protect the bellows from excess pressure or vacuum. The instrument is supplied with



"Packaged" boiler water treater

Injection molder for rubber

$4\frac{1}{2}$- and 6-in. plastic cases. One type is available in pressure ranges from 10 in. w.g. up to 10 lb. pressure. A modification is available as a low-range vacuum gage in vacuum ranges from 10 in. w.g. up to 20 in. Hg.

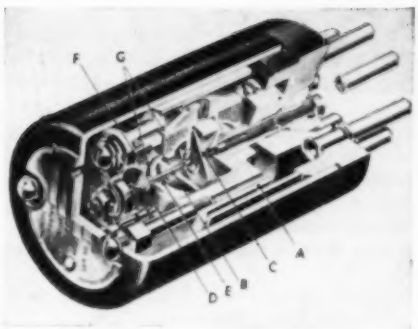
BOILER TREATER

CONSTRUCTION of the "package" type is featured in a new unit for boiler water treatment that has just been announced by Proportioneers, Inc., 29 Codding St., Providence, R. I. The new unit includes one of this company's Adjust-O-Feeders compactly mounted with a motor on the same base with a chemical tank and agitator. The unit is designed to feed all treating chemicals and compounds automatically for the effective control of scale, pitting and corrosion in boilers and associated equipment, thereby prolonging their life, improving heat transmission and reducing the need for shutdown for repairs and cleaning.

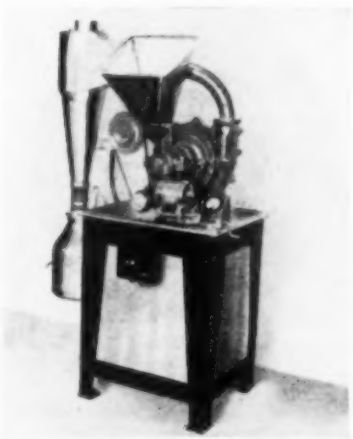
RUBBER MOLDER

PRODUCTION molding of both natural and synthetic rubber can be handled with the new Turbojector, a specially designed injection molding press developed by Hydraulic Press Mfg. Co., Mt. Gilead, Ohio. The machine injects rubber into a hydraulically clamped mold by means of a motor driven screw. The entire machine cycle is automatic and the unit is completely self-contained, with pumps and valves for controlling all hydraulic actions within the machine base. Only electric power and cooling water connections need be made to put the machine in operation.

Compared with conventional compression molding methods, it is claimed that the new machine greatly reduces production costs and curing time. Flash is eliminated and finishing operations are reduced to a minimum. A wide range of mechanical parts can be handled. Experimentally the machine has molded up to 8 lb. of rubber per "shot." It is driven by a 10-hp. four-speed electric motor and train of gears directly connected to the injection screw. Frictional heat in forcing the rubber into the injection chamber raises its temperature to 300 deg. F., while additional heat is added at the nozzle by means of an electrical resistance band heater. This preheating is said to account for the rapid curing cycles that can be obtained.



Compact sensitive relay



New No. 5 Mikro-Atomizer

SENSITIVE RELAY

DEVELOPED by the Instrument Division of Thomas A. Edison, Inc., West Orange, N. J., a new sensitive magnetic relay, Model 103, is now available industrially for such applications as amplification of the output of thermocouples and photocells. The device is compact, light in weight and is said to function dependably under vibration. It is claimed to be particularly useful as a polarized relay in vacuum tube circuits, in balanced circuits, and in applications requiring pull-in and drop-out at essentially the same current or voltage. The design employs stationary coils and a swinging permanent magnet, the two coils being connected either in series or differentially (so that the relay will operate on the difference between the current in the two coils). Operating power is normally about 10 microwatts while the contacts will handle $\frac{1}{4}$ amp. non-inductive load. The magnetic system, as shown in the accompanying illustration, is inclosed in a highly permeable metal shield *A* for protection against stray magnetic fields. Rotor *B* is pivoted in spring loaded jewel bearings and has a small Alnico vane *C* at its lower end. At its upper end is hair spring *D*, a balanced cross with weights *E* and a platinum-iridium contact arm F. The magnet vane is positioned between the two parallel stationary coils *G* whose magnetic fields are coincident. The total weight of the unit is 0.15 lb.

ULTRA-FINE PULVERIZER

SIMILAR in principle to the previously announced No. 6 Micro-Atomizer, but much smaller, is the new No. 5 machine recently announced by Pulverizing Machinery Co., 36 Chatham Road, Summit, N. J. This new mechanical, screenless, dustless pulverizer is suitable for small quantity production at capacities of 5 to 200 lb. per hour in the particle size range from 1 to 25 microns. The unit employs a 5-hp. motor and rotates at speeds from 7,000 to 10,000 r.p.m. As in the earlier design mentioned above, the new machine employs a new grinding principle, that of imparting a centrifugal force to each particle and opposing that force with an aerodynamic drag. A fan adjacent to a separator wheel exerts just enough suction to draw out and discharge the finest particles, while the coarser particles drop back into the path of the hammers until sufficiently reduced in size.

EQUIPMENT BRIEFS

A CHEMICALLY setting acidproof cement for a wide range of applications in the construction of tanks, towers, chimneys, concentrators, digestors, blowers, drains and other chemical equipment has been announced by Nukem Products Corp., Buffalo 20, N. Y. This new silicate cement does not require washing of the surface joints with acid upon completion of a job. Its compressive strength is said to be over 3,500 lb. per sq. in. and its tensile strength over 400 lb. Steam, hot or cold water, pulp solutions and acid solutions of all concentrations are said to have no adverse effect.

A PERMANENT magnet separator of the double Alnico magnet type mounted in a one-piece bronze frame is available from Prater Pulverizer Co., 1825 South 55th Ave., Chicago 50, Ill. The magnet is adaptable for mounting either on feed tables or spouts, at any point in the flow, for the trapping of tramp iron and steel.

A NEW DESIGN of free-rolling conveyor trolley that is extremely simple has been announced by Link-Belt Co., 300 West Pershing Rd., Chicago 9, Ill. The new design has no wheel shafts or spindles and does not require separate retainers for its full complement of hardened, accurately balanced alloy steel bearing balls. Instead, the wheel itself and the one-piece bracket

form the inner and outer races, respectively, of the bearing. Protective felt seals and adequate lubrication reservoirs are provided.

Of interest to maintenance and construction departments is the new carbide-tipped Cyclone Drill-Bit produced by New England Carbide Tool Co., 60 Brookline St., Cambridge 39, Mass. This device is used for drilling holes in concrete, masonry, ceramics and stone, using an ordinary rotary electric drill and eliminating hammering. One user reported, for example, that he was able to drill a group of holes in a brick wall in 80 minutes that by former methods would have taken 8½ hours. Furthermore, the bit had lost none of its sharpness.

Tests recently conducted by the Rapids-Standard Co., Grand Rapids 2, Mich., have shown that conveyor wheels that are grease-packed during assembly are less vulnerable to corrosion and give longer and more efficient service than standard wheels without lubricant. These tests compared the new special recessed-hub No. 11 grease-packed wheel made by this concern with wheels of the ordinary type, using intermittent running and idle periods, with brushing of the wheels with salt solution before and after each operation. After 61 hours of operation all wheels were cut open. The unlubricated wheels were in bad shape and virtually at the point of failure, while the pre-lubricated wheels were perfect internally, and much of the exterior had been protected by the small amount of grease seepage around the hubs. The new wheels are now being used on all this concern's wheel gravity conveyors.

Something new in a pipe joint compound is Pipetite-Stik, a stick type compound, similar to a crayon, that is being produced by Lake Chemical Co., 607 North Western Ave., Chicago 12, Ill. It is only necessary to rub three or four strokes of the stick across the threads. The material then spreads and fills the threads as the pipe is screwed into the fitting. The compound is said to serve as a thread lubricator, to permit disassembly of the joint after years of service, and to be proof against hydrocarbons, refrigerants, gas and acids. It is also suitable for use with food products.

Made of canvas impregnated with milled neoprene, a new work glove offered by the Synthetic Division of Pioneer Rubber Co., Willard, Ohio, is suitable for jobs that are too wet and sloppy for other types of work gloves. The milled neoprene is said to be tougher and more durable than the latex type and the impregnating process is such that the canvas and neoprene are joined in a permanent bond.

Known as the Bob-Cat Model, a lightweight, small-sized electric hoist has been introduced by the Lisbon Hoist & Crane Co., Lisbon, Ohio. The hoist is made in practically three sections, permitting complete and easy access to any part by the removal of about four bolts. Made of steel forgings and castings, its safety factor is claimed to be 6 to 1 or better. The motor is entirely inclosed in the drum, with a patented method of heat dissipation.

For fire fighting by the fog method, the United States Rubber Co., Rockefeller Center, New York, N. Y., has introduced a small-diameter, light-weight fire hose capable of withstanding 800 lb. working pressure. The fog is generated by forcing water under high pressure through a specially designed nozzle and is suitable for putting out many types of fires more efficiently than a solid stream of water.

Translucent Plexiglas is now being used by Pereles Bros., Milwaukee, Wis., in the manufacture of 10-in. slide rules which are minutely calibrated and are said to defy temperature changes, humidity and all factors which adversely affect wooden slide rules. The calibrations are molded in during manufacture which is said to assure long life and accuracy.

Model E interval timer

Although it is not entirely new, having been used for several years by instrument manufacturers, the Beck Mechanism made by Harold Beck Co., 3644 North Second St., Philadelphia 40, Pa., is now being offered generally for the first time. The device is a highly developed automatic control actuator which operates valves, dampers, rheostats and similar control devices. It employs three control functions: a proportional function, and a two-part reset function. The first reset function, which is the principal one, is proportional to the first function mentioned, while the second reset function is a timed impulse that is periodically introduced, proportional to the magnitude of the deviation, if the system is off the control point. This combination is said to permit close control of rapidly changing loads and to hold an exact control point free from drooping characteristics.

New electronic air filter

OXYGEN RECORDER

Continuous indication and recording of the oxygen content of a gaseous mixture is the function of a new automatic continuous analyzer developed by Bailey Meter Co., 1050 Ivanhoe Road, Cleveland 10, Ohio. The instrument has been used successfully, according to the manufacturer, in connection with boiler furnaces, kilns, chemical and petroleum processes, glass tanks and many types of metallurgical furnaces. It is said to be responsive to changes of 0.05 percent oxygen and to have a sustained accuracy within 0.25 percent. In operation a continuous gas sample is mixed with a vaporized liquid fuel and burned on a catalyst filament which reaches a temperature proportional to the oxygen content. Since the filament resistance is a function of temperature, its temperature and hence the oxygen content can be inferred by a simple resistance bridge connected to a null balance electronic recorder. A high-speed sampling system, coupled with the high speed of the instrument itself, is said to make it suited to traverse studies, as well as to continuous day-to-day operation.

INTERVAL TIMER

Several improved features are incorporated in the new Model E interval timer recently announced by the R. W. Cramer Co., Centerbrook, Conn. Developed to control the running time of process equipment, to control the duration of exposure (as in X-ray machines), and for similar purposes, the device has larger dials designed for easy reading and setting, a sturdier frame construction, and simplified mounting so that timers may be grouped on instrument panels in combination with other typical control and indicating instruments.

ELECTRONIC AIR FILTER

Electro-Cell is the name of a new unit type electronic air filter with removable collector plate assemblies that has recently been announced by American Air Filter Co., Louisville, Ky. The positive and negative collector plates are assembled on cross rods to form horizontal groups which are easy to handle and may readily be removed from the filter casing. Sliding into the filter casing in the same manner as a desk drawer, the plate assemblies can be removed for cleaning and re-oiling at convenient water and sewer connections. If a spare set of plates sufficient for one section is kept on hand as a replacement, the length of time the filter is out of service for cleaning can be minimized. An automatic washing device has been developed to permit collector plates to be washed in place in installations where manual washing is not feasible. Standard sections are 2 and 3 ft. in width with a capacity of 1,000 c.f.m. per unit. Larger capacities are secured by arranging units in parallel.

REPORT ON.....

MARKET RESEARCH

Symposium for Junior Chemical Engineers

Market research is a growing factor in the chemical industry. Today, with the problems of reconversion and the changing needs of producer and consumer, it plays a leading role in the postwar programs of the major process industries. A recent joint meeting of the New York section of the AIChE and the Junior Chemical Engineers of New York brought together a panel of chemical market research experts to give a representative group of chemical engineers a comprehensive look at the problems of new product development. This report gives the thoughts of these men and provides a timely discussion of many of its important functions and applications.

MAURICE R. LYONS, vice president of the Junior Chemical Engineers of New York, presided at a meeting of the organization held in New York on the evening of April 4, which was unique inasmuch as the local section of the American Institute of Chemical Engineers took over the program and contributed the speakers in a symposium on chemical market research. Most of the speakers also are members of the Chemical Market Research Association which was incorporated last year and which restricts membership to those engaged in research work in companies manufacturing chemicals.

The important part that chemical research in its many-sided phases, has played not only in the development of the chemical industry but also in the growth of many of the chemical-consuming industries, has been universally accredited. An instance of the contribution it has made to the national economy and more particularly to the creation of jobs may be found in the recently issued annual report of E. I. du Pont de Nemours & Co. A review of the company's employment experience over the last 20 years showed a growth in numbers of employees of 250 percent between 1925 and 1940, accompanying an increase of 350 percent in operative investment. In 1945 more than 27,800 of its employees were engaged in production and sale of products which either did not exist or which the company did not manufacture on a commercial scale in 1925.

The men who made up the panel of speakers for the symposium had long been engaged in research work which brought corresponding results within their own companies and they readily volunteered to speak to the younger men of the profession and pass on to them the benefits of some of the years of their experience. Dr. William H. Bowman, market development manager, Jefferson Chemical Co. was the guiding spirit behind the symposium. Asked to be the speaker of the evening, he recognized this as an opportunity for the men experienced in the field of chemical market research to present a program which would be of real educational service to the younger men. Accordingly he enlisted the aid of several engaged in research work and as the notice of the meeting sent out to members said "The program committee, in aiming for a speaker on the marketing side of the chemical industry, had the good fortune to find an entire panel of experts who were willing to spread their gospel, as widely as they might, to chemical engineers."

OPENING the discussion Dr. Bowman said that one thing about the chemical industry is quite generally recognized. It is always changing, never static. New products and new applications of old products are continuously under development. The long-term growth of an individual company hinges upon its ability to contribute to this development.

Taken in all its details, the job of selecting and developing new products—as well as developing new applications of old products—is a highly complicated one. The personnel engaged in it have more and more had to become specialists, each concentrating his efforts largely upon some one phase of the work; and this is no less true of those engaged in the commercial branches of the work than of those over the wholly technological side.

So far as the commercial branches of

product development work are concerned, the exact form which this process of specialization has taken varies considerably from company to company. So does the extent to which specialization has been carried. Job titles do not always mean the same thing in one organization that they mean in another. But in general, the various specialized functions can be grouped into three major categories: market research, market development, and technical service.

Market research seeks to acquire the information upon which executive decisions regarding research, production and sales are based. Market development carries new products and new applications coming out of the laboratory and pilot plant through the introductory sales stage. Technical service, by providing technical assistance to customers, strives to assure the acceptance of new products as well as the continued and expanding sale of old products.

It is evident that the dividing lines separating these three categories cannot be absolutely clean cut. Indeed, in spite of the trend toward specialization it is still not uncommon to find a single individual performing duties in all three fields.

To the uninitiated, this picture is bound to seem rather confusing. That is the reason for this symposium. Each of the contributors is a specialist in some phase of product development work. Each of them is a member of the Chemical Market Research Association or the Technical Service Group of the Chemical Industry or both. These two professional organizations have come into being only within the past few years, which is an indication of the growing importance being attached to the commercial side of product development work.

These contributors, moreover, come from a wide variety of chemical producing companies. This symposium consequently represents a cross-sectional view of the commercial aspects of product development. It should shed a great deal of light upon a complicated subject.

FOLLOWING Dr. Bowman, Kenneth H. Klipstein, manager, New Products Development Department, Calco Chemical Division, American Cyanamid Co., spoke on "The Philosophy of New Product Development." He said there is no black magic in new product development. On the contrary, the approach to new markets can be made simple and systematic. It requires only a little perspective and a lot of hard work. It is a natural for the chemical engineer.

First of all, and most important, is a proper attitude of mind. The word "new" inherently implies something different. The carriage maker went out of business doing the same old thing in the same old way. His next door neighbor added a motor and stabled the horse. Feed your imagination with vitamins. Edifices and instruments are important but secondary.

The new must also be useful. There are hundreds of thousands of chemicals collecting dust in Beilstein. Those in the salesman's manual are there because they perform a service for the customer. No chemical has a value without a use. An indispensable part of new product development is evaluation of functional properties. DDT, sulfanilamide and melamine would all have been in production long ago if someone had just only tried them out in the right place in the first place.

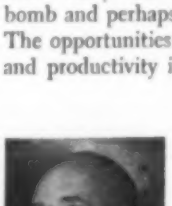
Having demonstrated the utility of the new product, the next question is whether it can be produced economically. Process development thus becomes an important factor in the success of the project. During the war, the Ordnance Department asked industry for dinitromethylaniline for tetryl manufacture. Dinitrochlorbenzene and monomethylamine were the raw materials. The problem was how to make enough pure dinitrochlorbenzene. A simple chemical engineering change in process permitted the use of ordinary dinitrochlorbenzene, of which plenty was available, and the bottleneck was broken.

Novel, useful, practical and next, is it worth the effort? The answer must be given by market research. Business is based on profits. Trends in industry and unfilled demands require careful analysis and shrewd forecasting.

Thus research, seeking the new; application and technical service, evaluating functional properties; process development, assuring economical production; and market research, gaging the return—each makes its contribution to new product development. Like a relay race, first one then the other carries the baton until sales crosses the finish line.

Continuity must prevail throughout. The coach of the race may have a different title in every organization but his function is always the same. Orderly progression from one stage to the next is essential to the successful conclusion of any project. These chemicals of ours have no mind of their own.

Each new product and each new use opens the door for many more. Each serves as a stepping stone for further technological progress. Sulfanilamide led to sulfadiazine. Madame Curie's studies of radium were really the beginning of the atomic bomb and perhaps harnessed nuclear energy. The opportunities are therefore ever greater, and productivity is the key to prosperity.



ANOTHER phase "Technical Service and the Chemical Engineer" formed the topic of Lawrence H. Flett, director, New Products Division, National Aniline Division, Allied Chemical & Dye Corp., who said the chemical engineer is the builder of the chemical industry. Before he can start to build a plant, he must know what is going to be made in the plant and how much is going to be made. These figures are obtained from sales department estimates of what can be sold and how much can be sold.

When the chemical engineer has completed the plant design and estimated the cost, he is again stopped until the money necessary to build the plant is appropriated. Money for the construction of new plants will be appropriated by the management if the new plant will manufacture chemicals which can be sold at a profit which offers a reasonable return on the business risk involved. The calculation of what the profit will be is again based on the sales department estimate of how much can be sold and it is also based on the sales department estimate as to what price that amount of material can be sold for. Thus it can be seen that the sales department must provide estimates before the chemical engineer can start designing and before he can start building.

When the sales department estimates that it can sell material that cannot economically be made in the present plant, it is making a forecast of the future. This forecast is a serious responsibility because if it is wrong, the new plant may prove worthless. In recent years the size and cost of modern chemical plants has become so great that no company is willing to sustain such a loss. This state of affairs has resulted in a general effort throughout the chemical industry to arrive at more accurate data on future sales so that the risk involved in costly plant installations may be reduced.

The necessity for more accurate predictions has brought about the use of chemists to speed up the introduction of new products and to determine the acceptability or marketability of chemicals. These chemists work in departments with almost as many different names as there are different companies. They are represented here by members of the technical service and market research groups.

The men in these technical marketing organizations deal with the future, but they are not mystics nor soothsayers. They make their predictions based on a collection of data in exactly the same manner as a chemical engineer predicts the performance of a piece of chemical equipment from experimental data.

The technical service and market research chemists are concerned with expanding the use of chemicals both by the introduction of new chemicals and by developing new

uses for chemicals which their companies manufacture. They seek to provide their companies with charts which can be used in preparing a program of orderly expansion.

The chemical engineer can obtain from these groups valuable information about the future of the chemicals which are to be made in the plant he builds. Chemical plants are not static things; they are growing things. Like growing animals they can be crippled by binding any part so that it cannot grow. The chemical engineer who is conscious of his responsibility must look to the future and make certain that he does not cripple his plant by adding a growing part in a location where it cannot grow.

If a new chemical is to be made in a new plant on a new piece of ground, the problem of providing for expansion is comparatively simple. Probably all of you here are chemical engineers in plants which already exist and which are already growing. Your problems are made more difficult by the fact that all parts do not grow at the same rate. A rapidly growing chemical installation in the middle of a busy plant is like a cancer that grows until it throttles the productive capacity of the whole plant. Chemical engineering that does not provide for the future may lead to company failure.

In the design of a plant it is important to have some idea of the rate at which it will grow. Will the growth of the new plant be slow so that the addition of several new pieces of equipment will permit adequate expansion for a reasonable number of years, or will the necessary expansion be so rapid that it will become economical to entirely abandon the original site and leave it as a pilot plant? The chemical engineer needs that information and he obtains it from his technical marketers.

Another valuable service which the chemical engineer can render is to take into consideration the possibility of other products which can be made in the new plant. It is desirable for him to know whether the new product which is to be manufactured is going to be one of a whole group of very similar products. For instance, is it to be the first of a new line of dyestuffs to be followed by similar products of different color, all of which could be made in similar equipment? It is always good insurance to have a plant which is capable of manufacturing more than one product.

The chemical engineer is responsible for an orderly expansion of the manufacturing capacity. In designing a plant he should find out whether the chemical to be manufactured is one which can be sold in great quantities at a low price or whether production will be small and grow slowly. If the production is to be small, the chemical engineer cannot justify the time and the expenditure of money required to introduce simplified operations or self-operating equipment. On the other hand, if the product is to be made on a large scale, simplified operations should be introduced in the early stages of the pilot plant development.

The chemical engineer who has information on the future can avoid the problem of introducing an entirely new process at a time when he is faced with the engineering problems of a major expansion.

Probably the most difficult part of the chemical engineer's work in solving these and other problems is to get exact information as to what is wanted. In collecting the information necessary to his work, he is neglecting the company's interest if he does not obtain the picture of the future which is provided to him by the market research and technical service groups of his company.

To Richard M. Lawrence, Development Department, Atlas Powder Co., fell the task of advising the young chemical engineers on "Finding the Facts and Figures for Chemical Market Research." He pointed out that the night's symposium emphasizes the fact that successful developments are cooperative campaigns requiring the teamwork of a variety of experts.

All of them will agree that the best managed research and development projects comprise a succession of "crucial experiments" to which a negative answer automatically eliminates further exploration of barren territory. Many such crucial experiments lie in the field of market research, in the evaluation of such factors as prices, raw material costs, tariffs, plant locations, capacities, production, consumption in various industries, use patents, legal restrictions, imports, exports, transportation rates, and taxes.

Evaluation of the strength of competition involves many factors affecting the position of individual companies such as plant locations, lines of products, manufacturing facilities and processes, disposition of by-products and waste products, financial standing, customer industries and companies, markets, potential developments, and competitive situation with reference to other companies, imports, and substitute products.

As these market research factors are often the factors which spell success or failure of a project, market research, in a well integrated company, precedes, as well as parallels, technical research. Complete familiarity with sources of data is essential to a rapid and effective approach to the "terminal" problems of analysis, interpretation, and presentation.

The chemical market research man begins with the available sources of information in his own company: The sales department, the purchasing department, the traffic department, and other "eyes and ears of the organization." Information from internal sources is supplemented with correspondence and field work with suppliers, customers, government bureaus, trade associations, universities, public utilities, and other contacts.

Much of the basic information of chemical market research is scattered through a wide variety of literature sources, of which governmental bureaus are the major publishers. There is also a large number of private sources such as trade journals, yearbooks, industrial directories, financial advisory services, manufacturers' catalogs, and chambers of commerce.

A good government survey on a product may have cost $20,000 and be available for 25 cents. It is obviously important that no such valuable sources be overlooked, and they must be ordered promptly before they get out of print. Although market research data sources get out of date rapidly, many of the old reports are valuable for providing background and methods of analysis. A good trade directory, with data on plant locations, capacities, and key personnel, often constitutes a ready-made list of prospective customers for chemicals and equipment.

For basic statistics of chemical production, the major publications are those of the Census Bureau, which cover all manufactures; those of the Tariff Commission, which cover synthetic organics in great detail; and those of the Bureau of Mines, which cover minerals and metals and a number of related chemicals. Statistics of imports and exports are published in the Census Bureau's detailed annual "Foreign Commerce and Navigation of the United States" and in monthly publications.

The Bureau of Foreign & Domestic Commerce makes continuous studies of virtually every phase of business and issues many valuable reports and periodicals. Of especial interest to us are their monthly "Industry Report" on Chemicals and Allied Products and their Industrial Reference Service presenting special studies on chemicals, drugs, and other products. Their "Survey of Current Business" includes over 2,000 statistical series, designed to answer the perennial question, "How's Business?"

One of the great market research events of recent years was establishment of the "Facts for Industry" series of reports, with monthly data on production, consumption and stocks. Issued by he Census, these cover not only chemicals, but also more than 100 other product groups including paints, fats and oils, pulp and paper, superphosphate, plastics, and plywood. One of these reports presented a map showing the location of every sulphuric plant in the country.

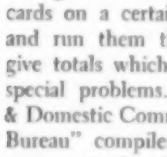
Other series of basic figures concerning the chemical and process industries are published in the Department of Agriculture's annual "Agricultural Statistics" volume, special reports (naval stores, wood preservatives, fertilizers, etc.), and monthly publications. A number of valuable series of

commodity figures of narrower scope are regularly published by the Treasury Department and other governmental units.

Most foreign countries publish statistics of imports and exports and the principal industrial nations publish production figures, but usually in far less detail than those of the U. S. Government.

Leading trade journals in most fields usually republish government statistics in regular or annual issues and yearbooks. Many trade associations publish their own and government statistics on production, imports, exports, and prices.

The Washington bureaus have in their files vast quantities of information from which they have published selected material believed to be of greatest importance for the problems of industry and government. Obviously they can't publish everything. This leaves a great deal of information in their files, much of which is not confidential, which the bureaus will be pleased to make available through correspondence or interviews. It is also possible to obtain from the Census Bureau, for a moderate fee, copies of non-confidential tabulations which might, for example, have been sub-totals on their work sheets for figures which went into their grand totals that are published. They can also arrange to select groups of their punch cards on a certain industry or certain area and run them through their machines to give totals which are of value for studying special problems. The Bureau of Foreign & Domestic Commerce, "The Businessman's Bureau" compiles many special reports in response to inquiries. Department of Commerce offices in principal cities render effective assistance in getting information from Washington.



DEVELOPING the subject "Field Research," Paul J. Carlisle, manager, Field Research Division, Electrochemicals Department, E. I. du Pont de Nemours & Co., said it is undoubtedly true that the chemical industry, driven by the incessant prodding of science in its search for truth, is more subject to major changes than any other industry. The scientific spirit, ever striving for greater knowledge and understanding of truth, for man's greater domination over the materials and forces of nature, and for the improvement of man's life on this earth, is the great driving force in the heart of mankind. This God-given spirit which burns in the hearts of scientists and industrial executive alike, is at the very root of the greatness of America. Who can doubt that the chemical industry is the leader in this endless sweep of progress?

This situation inspired someone to describe it in a single, brief sentence, "The only permanent thing in America is change." There is a constant succession of new and better products. They are better in that they are of higher purity, or have new or improved properties and will do things no other product ever did, or are made at lower cost, or are characterized by all of these things. No product, no matter how novel or useful, is safe from the threat of competition by duplication at equal or lower cost or by discovery of other new products of similar or superior properties.

Any company which has the capital and fortitude to occupy or acquire a place in this characteristic American picture, knows that one of its first necessities is a means of keeping constantly informed of everything that is going on within the confines of this country, and even the entire world. The company cannot exist very long without it. Of course, information from the industries of the country is constantly fed to the company by its salesmen, technical service men, sales development representatives and members of the research staff. However, most companies find it necessary to create a division or section charged with responsibility for developing new products and new activities for the company and for insuring that the organization knows what America is doing and where the best opportunities are for serving mankind and hence, the stockholders.

Such a division or section is called by different names, e.g., Market Research, Technical Service, New Product Development, Field Investigation, Field Exploitation, Field Research, etc. There are honest differences between the activities designated by these names but in the long run they all mean more or less the same thing.

The speaker's particular section is known as the Field Research Section of the Technical Division. The work consists of two principal divisions, (1) new product development and (2) providing a field intelligence service. Essentially, the new product development work consists of determining whether attractive markets can be found for potential new products. In carrying out this work the Field Research Section is responsible for correlating all phases of the program, e.g., research, process development, patent protection, maintaining adequate development stocks of materials, appraisal of potential new products, costing and pricing, the selection of the most suitable method of market development, carrying out the necessary field work and finally, if the work is successful, transferring the market picture to management for executive action.

The field intelligence service consists of miscellaneous special assignments, usually intended to develop commercial data concerning specific items. A growing part of this type of service is in studying and reporting commercial aspects of proposed research before time and personnel are devoted to carrying out the research. Other divisions of this work consist of periodical and frequent visits to research institutions, university laboratories, government laboratories, and consulting laboratories; also the study of current problems and trends in selected industries.

CONTINUING the discussion, Dr. James H. Boyd, Jr., eastern representative, Research and Development Departments, Phillips Petroleum Co., talking on the subject "Chemical Market Development-Procedures and Problems," defined chemical market development as the art of finding a home for homeless chemicals. A new chemical commonly passes through this stage in progress from a laboratory curiosity to an industrial chemical. In effecting the transition from laboratory to industry, the procedure commonly followed in market development work is to examine the physical and chemical properties of the chemical in question and then let analogy to the properties of currently useful materials indicate the possible fields of application for the new chemical. With these leads our hopeful market development man starts his search for people sufficiently curious to evaluate his new product. If, after preliminary laboratory evaluation, the product is found to have technical merit larger samples are required for larger scale testing. While this work is progressing, it is necessary to develop simultaneously the relation between the selling price and purity of the chemical and to determine product specifications which protect the prospective buyer without unduly penalizing the manufacturer and seller. Assuming that these questions are settled satisfactorily a successful plant trial is prerequisite to adoption for use in plant production. This last step means our new chemical has a home at last.

To illustrate, the writer was recently assigned the market development of 99 percent pure normal heptane whose availability in tank car quantities has just been announced. The properties of the current production of this normal heptane are:

Distillation temp., deg. F.	209
Freezing pt., deg. F.	−131.4
Density @ 68 deg. F., g. per ml.	0.6839
Refractive index @ 68 deg. F.	1.3877
Octane number, max.	0.5

Inspection of the above figures shows its potential value as a reference fuel since the octane number of gasoline, the quality reference for motor fuels, is simply the percentage of isooctane in the isooctane-normal heptane blend which has the same combustion characteristics as the fuel under test. The octane number of the current production of normal heptane does not exceed 0.5 maximum and with further experimental background will doubtlessly be found to be less. The reference fuel use, however, is one which is already developed, and which is limited in extent.

Possibly pure normal heptane is of value as a special solvent or precipitant in the paint and varnish industry. While the paraffins are very poor solvents in sense of solids carrying capacity, their low solvent power becomes a virtue when "false body" is desired in order to obtain good brushing qualities with a minimum of the resinous or resin forming materials. Possibly normal heptane may have value as a chemical intermediate. One wartime use of a restricted character has been discontinued, but it is sure evidence that at least in one field, normal heptane has desirable properties as a chemical intermediate.

You will note that we do not have the answer to my assignment. That is why there is a problem, and if you can aid me in its solution, you may be sure that your suggestions will be most welcome.

GIVING wider diversification to the discussion, Fred A. Soderberg, head, Paper Department, Service & Development Division, General Dyestuffs Corp., spoke on "Technical Service to Customers" and in the course of his remarks said that chemical products are usually considered by the prospective purchaser on one of three premises: political expediency, personal likes or dislikes, and benefits to be derived by the company.

Fortunately no one individual has all the attributes necessary to meet these requirements, therefore, competition is extremely keen. By political expediency we mean the pressure which is brought to bear by people within the company upon their purchasing department. This is what is known as reciprocity. There is very little that the technical service man can do to combat such a condition despite the fact that it is economically unsound. The personal likes and dislikes of the purchaser are extremely important though generally they are the principal concern of the salesman. One of the prime arguments in favor of having technical service men as well as salesmen call upon the customer, is the fact that his personality may appeal to the individual who has the final decision in buying.

As mentioned before, no one man can get along with all types of personalities—the salesman or the technical man who believes otherwise is a confirmed egoist. When the salesman endeavors to do his own technical work, customer coverage will be sharply reduced with a resultant vulnerability to competitor's attacks. The forte of most technical service men is their ability to suggest beneficial ways and means of improving quality and reducing cost. In our particular field which is dyestuffs, we endeavor to sell our products on a finished material basis. By that we mean the cost to our customer as the completed product leaves his plant. It is a well known fact that a few pennies saved in initial cost may backfire and produce dollar losses before a commodity has reached the marketable stage.

To illustrate the fallacy of basing all computations on the prices of raw materials, we would like to give you briefly the details of one of our experiences:

A manufacturer wished to color his product a deep orange shade and on the basis of strength and price per pound selected the cheapest dyestuffs available. These colors were so sensitive to acid and alkali that wide variations in shade were encountered with the subsequent rejection of large quantities of the finished material. Technical assistance was requested and it was possible to lower the end of process color costs while increasing the price per pound of dyestuffs used approximately 50 percent.

Many times we are faced with the necessity of deciding just how much assistance should be given to a particular account. Years of experience have taught us to give large concerns all the help we possible can. If you do an outstanding job of technical service, the good will of the customer may be yours for a long period of time.

As we advance in the chemical industry, it becomes increasingly apparent that someone will have to educate the consumer to appreciate quality products. Someone will have to impart an understanding of the benefits to be derived which will justify the cost. Someone will have to supply the impetus which turns a refusal into a sale.

The technical service man has the qualifications to meet this challenge!

THE SECOND portion of the program was in charge of James G. Bronson, assistant divisional sales manager, Westvaco Chlorine Products Corp. Many from the junior organization had previously submitted questions on various aspects of research work and those which were deemed to be of widest interest were turned over for prepared answers to members of the panel who were especially qualified to handle them. Following the presentation of these papers questions from the floor were in order and this section of the program proved to be very informative. While the questions generally were directed to a specified individual, frequently different members of the panel discussed the same question with the result that a comprehensive view was given of how different companies had solved the same research problem.

A typical question, and one which seemed too complicated to admit of definite answer, dealt with the method to be followed in getting an entirely new product into the hands of possible consumers. In addition to the procedure necessary for the development of consumer interest, the question of whether or not to place a price on workable samples must be considered. In some companies, the establishment of prices is a function of the sales department while other companies give the research department authority to give away introductory amounts of a new product or to sell them up to a specified dollar volume. Under present government price restrictions, the price fixed for introductory purposes may become the ceiling level.

THE FIRST speaker introduced by Mr. Bronson, was William H. Harding, technical service director, Stamford Laboratories, American Cyanamid Co. who said your chairman has very kindly given me advance information on two questions which would be directed to me, as follows: "How does applications research differ from just plain research?" "To carry on applications research, I assume that the laboratory man must be made familiar with applications of chemicals. How is such familiarity arrived at in practice?" Since these questions are closely interrelated, I will try to give you an answer which covers both.

Fundamental research is concerned with the investigation of new reactions and the synthesis of new materials. Frequently there is no particular end use in view, since in many cases the investigation was initiated to broaden our knowledge of certain fields in which we have a particular interest (perhaps due to a favorable position in raw materials or basic patents). While the fundamental research man who has synthesized a new material usually has some ideas as to its possible uses, he usually has neither the time nor the general commercial background to investigate its applications.

It is, therefore, desirable to set up applications research laboratories, which are staffed and equipped not only to investigate the possible uses of these materials but also to work out application techniques. It is obvious that each of such groups must have an intimate knowledge of the industry to which we hope to sell raw materials. We have, therefore, made it a practice to get as group leaders men who have had broad experience in the several industries which we serve. Such men must have intimate knowledge of the use requirements of materials used in the industry and must be familiar with current production methods. Since a man cannot be kept fully up-to-date by second-hand information, our men are encouraged to visit our customers and attend meetings.

In starting a new group to serve an industry with which we are not familiar we try to obtain the services of a man who not only has worked in the industry but who also has a flair for development work and ability to get on with people. It is possible to use as assistants men who have had sound fundamental training in chemistry or chemical engineering but who have had no experience in the industry. These men acquire a knowledge of the industry from the group leader and such other colleagues as have had experience in the industry and also get first-hand knowledge by accompanying our field men on demonstration and trouble-shooting visits.

Another question which was asked was: "How are new products transferred from the laboratory to sales?" After a product has been thoroughly tested in the laboratories and, in our opinion, has sales possibilities, a meeting of representatives of the interested sales and field service men with the laboratory staff is arranged. Data and exhibits are presented. If at this point there is general agreement that field trials are warranted, the product (which has been given a number followed by the letter "X" for experimental) is turned over to one or two of the field service men for further evaluation at the plants of a few selected customers. The trial runs are made under the supervision of the field service men responsible for the accounts, and in many instances a laboratory representative is also present. This is particularly necessary when the use of the new material involves changes in ordinary application methods or entirely new methods.

If these trial runs are again successful, the material, still bearing its experimental number, is given to all of the field service men. Upon successful completion of these more extensive trials, the material is given a final name and number and is added to our list of standard products.

ANSWERING the question "Before Making New Product Sales, How Do You Go about Developing Demands Which Are Presumably of Unknown Value?" Edwin I. Oppel, manager, Pigments Development Product Division, New Jersey Zinc Sales Co., held that there is no one general set of principles that is applicable to all products, except to say that in its broadest aspects this is really an educational problem. Sometimes this educational problem is a simple and obvious one which can be carried all at one level; in its more complex phases it may require education at a number of different levels. An example of the latter may be found in the experience of my company with a new group of products, fluorescent and phosphorescent pigments.

A combination of circumstances shortly before the outbreak of World War II put The New Jersey Zinc Co. in the business of manufacturing fluorescent and phosphorescent pigments for the Armed Forces. Fluorescent pigments during the war found extensive use in airplane dials, maps, computers, etc. Phosphorescent pigments were required for a number of essential applications for marking areas and objects on ships and in the field during black out conditions.

As the end of the war approached, our postwar market outlook shaped up something about as follows: We were manufacturing on a tonnage scale two groups of specialized products for which the prewar uses were limited to very small demands from the theatrical and novelty fields. Technically, these materials were not new at all and, even though the company was now in a position to sell these products at prices far below the prewar level, very little could be predicted about the peacetime commercial demand because the products were so little known, technically difficult to handle in many instances and there were not too many obvious parallels between the wartime uses and the peacetime uses.

Our job, as we visualized it, was to conduct an educational campaign with ultimate consumers who, in most cases, were six or seven stages removed from us as a raw material manufacturer. At the same time we realized that a similar educational job, but perhaps one presented in different terms, had to be carried on at some levels closer to us as raw material manufacturers. This could best be termed a combination of "shot gun" and "sharp shooting" tactics.

Several specific ways in which this problem was tackled—and is still being tackled—include:

(1) Advertising a booklet called "The ABC of Luminescence" that was non-existent at the time the ads were run in a wide variety of media. We had a general conception of the booklet in mind but wanted first to get a broad scale response from every type of industry which would guide us in the preparation of a booklet that was designed to acquaint both technical and non-technical people with the knowledge of fluorescent and phosphorescent pigments where they had none before.

(2) Follow-up of this advertisement by broad scale mailings to industries of many types.

(3) Tailor made publicity stories in a variety of trade papers.

(4) Personal contact by technically trained men with industries in the plastics, paint, paper and textile fields. (During the war only a small number of specialized companies used these pigments on war contracts and industry knowledge of fluorescent and phosphorescent pigments was not large.)

(5) Placing of educational orders with manufacturers. Where the manufacturer had neither the incentive nor the know-how to go about developing any demand for a product made with luminescent pigments, The New Jersey Zinc Co. carried the ball. An example of this was our purchase of experimental orders of plastics, paper and textiles pigmented with fluorescent and phosphorescent pigments which our technical men sampled for the purpose of locating interest and then converting it into engineering interest, then potential demand which we could feed back to the manufacturers of these articles. This at the same time developed a technical know-how for the plastics or paper manufacturers as the case may be.

(6) Our salesmen were equipped with the widest variety of samples we could provide them with, and were asked to show these to anybody they might contact. Visual illustrating and demonstration were found to be essential.

(7) Individuals who received our booklet "The ABC of Luminescence" were also sent detailed questionnaires after an interval to determine broadly three things: (a) interest, (b) type of interest, (c) intentions and what we ought to do next.

IMPORTANCE of technical sales literature as an aid to product sales was the basis of the question assigned to Walter Helbig, chemical engineer, Sales Department, Darco Corp., and he began by saying that in the brief time allotted, it was of course not possible to give a complete answer to this question. We can, however, concentrate on one function of technical literature, viz: as a competitive weapon. Several of the previous speakers have commented on that aspect of technical service which demonstrates to a customer that the product being presented should be considered in terms of its specifications rather than its price. The objective is to prove that despite a relatively higher price, the superiority of the product permits a lower cost for the operation in which it is used.

As a competitive weapon technical sales literature can be looked upon as an extension of this aspect of technical service, which continues to work for the salesman after he has left his prospect. To be effective, the literature must present appreciably more than a description of the product offered, and of its method of use. It should prove clearly, and whenever possible in a quantitative way, how and why its superior properties permit production cost savings. It can reach a very high degree of effectiveness if it describes simple and convincing procedures whereby the prospect can verify for himself that the claims made are true.

However, technical sales literature of this type should not be written in the same way as a technical paper. The sales literature

should be written for use rather than for study; all calculations to be used by the reader, for example, should be performed for him, and given as graphs or tables, rather than in the form of an equation. In our experience this is highly important; we have found that technical men perfectly competent to solve equations will not take the time to do so, but will gladly use a graph or table.

Technical sales literature, carefully prepared, can be a powerful aid to product sales, but only if it can win a favorable decision in that fateful choice to which all literature is subjected when first read: shall it be kept, or shall it go into the waste basket. If it is useful, readable, rememberable, and dramatically presented, it will usually be kept, and will be a member of your sales staff constantly present with that customer.

A RATHER lengthy question of what sort of relation should exist between technical research and market development for most effective new product development was handled by Dr. George P. Vincent, technical director, Mathieson Alkali Works, Inc. His answer was that the relationship between the research organization and the market development department should, of course, be cordial. The interdependence of these departments should be recognized by each. The self-interest of each department is best served by the success of the other. Research is of very little value if the market development department cannot commercialize it, and the market development department can have no new markets to develop if the research department is not successful in the completion of its ventures.

There is always a clamor by market development for new products and this department sees clearly its dependence on research. There is sometimes a tendency for research to have limited interest only in market development. This tendency of nonrecognition of market development problems, which may result in research time being spent on projects which may have limited sales possibilities, works against the best interests of research.

The object of research is to develop materials which can be sold for a profit and the profit motive should not be lost sight of, not only because of what it means to the stockholders, but because it means a service is really being rendered. The research man can adopt some of the market development man's attitude on this to the benefit of both departments, the company, and the nation. Profits simply mean that an organization is doing something for people in general. Possibly one of the best ways to be assured that research and market development have a close and cordial relationship is to give a good technical man with sales instincts and training real authority in the research department, or to have such a man in the market development department in a very intimate liaison position with Research. Such liaison relationship would be one of definite authority in research policy, even though it would not include authority in research routine.

NEXT speaker listed on the program was Melvin E. Clark, director of market research, Wyandotte Chemicals Corp. Mr. Clark was unable to be present but his paper follows: There was a time when the sales forecast was a single statement by the sales manager to the effect that "business conditions look good for next year—we should do a little better than this year."

Too often the thought processes leading to that conclusion took little more time than was required to write it down. Nowadays in any business of appreciable size, future sales possibilities are analyzed and budgeted as carefully as are the company's future expenditures. The sales forecast is a basic factor in determining the schedule of plant operations, contracts for purchase of raw materials, provisions for inventory, hiring of labor, appropriations for capital investment and policy for sales contracting.

Forecasting is not essentially statistical though many people have come to regard it so. Actually a forecast is a conclusion regarding future accomplishment arrived at by considered judgment. It is usually set forth in figures because the mind grasps a conclusion better in that form and because measurement is more precise.

Market research plays an important part in formulating the forecast. There are three fundamental cornerstones on which a forecast is based. First is the environment in which the firm is to operate. This involves guesses as to whether the Democrats or Republicans will run the government, whether or not there will be war, whether people will save or spend their earnings, whether employment will be sufficiently high to maintain purchasing power and numerous other remote factors. Obviously this is a job for a combination economist and seer. It should not be done by one person but should be the considered judgment of the company management.

Second fundamental is the position already attained by the firm and its relation to the economy as a whole. Market research, aided by competent sales analysis should provide the answer. The answer usually includes (1) finding a barometer of business activity that fits and is related to the market (index of production, national income, autos licensed, wheat acreage planted or what have you), (2) assessing the trend of company sales versus industry sales and (3) a projection of (1) and (2) based on the assumptions relating to environment.

Third and seldom least, the forecast must embody an analysis of the competitive forces which can and may be brought into play. This includes the management's *will* to improve its company's position, the ability of the sales department to sell, the comparison of product quality, the cost of production and similar factors. Market research will answer some of these questions but the broader function "commercial research" plus management must answer them all.

It is readily apparent from this brief description that while the market research department plays an important part in the job of sales forecasting, actually that job is performed by a team comprised of almost every major department of the company. When completed the forecast may still be stated in simple terms but it becomes more than an offhand "Guestimate." It is a statement of policy uniting the entire organization in a drive toward a common goal.

As an editorial supplement to its issue of February 1936 *Chem. & Met.* published a check list of questions to be answered at each new step in new product development. While this has had wide distribution, it may not have come to the attention of some of the younger men who are coming up in the profession. The check list is now being reprinted and copies of it will be sent to those who send their requests to the editorial department.

The National Industrial Conference Board recently released a study on organization for market research and the following are summaries of practices which the Board found to be prevalent in companies which are producers of raw materials:

Of the 20 companies reporting, 11 had separate centralized departments. This is a higher proportion than was reported by the consumer product manufacturers. In this and succeeding comparisons of companies manufacturing or extracting raw materials with companies engaged in manufacturing consumer products, differences in company size are an influencing factor. The median-size company in the raw material group had sales of $22½ million in 1939, or more than twice the median company in the consumer product group.

Of the 20 companies manufacturing or extracting raw materials, 12 had in charge of their market research men called "director" or "manager" of market, sales or commercial research. Only one company reported that the work was in hands of the sales or sales promotion manager. Although the average department employed the equivalent of 14 workers, the median department was composed of only five. One company employing 100 workers and another

40 caused the wide difference between the average and the median.

A quarter of the departments represented report directly to the president, as compared with a fifth in the case of departments in the consumer-product industry. The market research department reports to the sales executive in over a third of the companies.

Position of Department in Company Organization

Report to	Number of Companies
President	5
Sales executive	7
Executive vice president	2
Other	6
Total	20

The distribution of the department's time is very similar to that of departments employed by consumer-product manufacturers. Nearly three-quarters of its time is devoted to the problems of the sales department, about 60 percent each to advertising and production, and only 3 percent administrative problems. The remainder is given to the study of miscellaneous problems.

Distribution of Department's Time

Department	Percent of Time
Sales	73
Advertising	6
Production	6
Administrative	3
Miscellaneous	12
Total	100

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By permission of *Chemical Industries*, the following is a reprint of some of the articles published by Richard M. Lawrence:

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- Pulp and Paper
- Chemicals and Allied Products

Inquiry Reference Service (Synopses of Information) (free):

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Part 2: "Chemicals, Drugs and Pharmaceuticals," $2 per year, or 5¢ per report if ordered singly. About 40 reports to date.

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Volume II (Publication resumed, 1945) $2 per year, 5¢ per report if ordered singly.

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- "Facts for Industry" Index of Publications (October 1945)
- U. S. Foreign Trade Statistical Publications:
  - (a) reports covering calendar years 1941-1944
  - (b) monthly reports starting with statistics for January 1945

Census Publications, Price List 70-24th ed., May 1945 (Lists stocks of the Superintendent of Documents)

Statistical Abstract of the United States (A) $1.75.

Facts for Industry Report Series

Date on production, consumption, stocks, shipments, etc. Most series start with 1941 or 1942. All are free on request.

Chemicals and Allied Products
- Series No.
- 6-1 Chemicals (inorganic) (M)
- 6-1-1 Supplement No. 1, Sulphuric Acid, 1943 and 1944.
- 6-2 Chemicals—Synthetic Organic (Order from U. S. Tariff Commission (M))
- 6-3 Chemicals (selected products of mines, coke ovens and smelters) (M)
- Mi5F Pyroxlin Coated Fabrics and Paper (M)
- M17A Animal and Vegetable Fats and Oils (M, Q, A)
- M19D Superphosphate (M)
- M19J Paint, Varnish, Lacquer and Fillers: Trade and Industrial Sales (M)

Paper and Allied Products
- 24-1 Census of Pulp Mills and of Paper and Paperboard Mills (A)
- 24-2 Paper and Paperboard (M)
- 24-3 Wood Pulp and other Fibrous Materials (A)

Miscellaneous
- Series No.
- 1-6 Aluminum (Primary Production and Secondary Recovery) (M)
- 1-7 Magnesium (M)
- 5-3 Dry Cell Batteries (Production and shipments by Type) (Q)
- 3-1 Storage Batteries (Automotive Replacement Type, Shipments) (Q)
- 27-1 Safety Equipment (A)
- M26D Asphalt and Tar Roofing and Siding Products (M)
- 5-13 Enameled Ware (A)
- 16-1 Softwood Plywood (M) 16-3
- 16-3 Hardwood Veneer and Plywood (M)
- 9-4 Glass Containers (M)

Foreign Trade Report Series

The following periodicals each comprise 12 monthly issues and a yearly issue (price marked "Y"). Yearly subscription prices (13 issues) are marked "S".

Order by number from the Census Bureau, with checks payable to treasurer of the United States. Following titles are abbreviated.
- FT-100 Imports. Commodity totals $0.10y $1.25s
- FT-110 Imports. Commodities, by countries 145y 3.50s
- FT-120 Imports. Countries, by commodities 1.45y 3.50s
- FT-400 Imports. Commodity totals .10y 1.25s
- FT-410 Exports. Commodities, by countries 1.50y 12.00s
- FT-420 Exports. Countries, by commodities 1.35y 11.00s
- FT-800 U. S. Trade with territories and possessions .10y 1.25s

Dept. of Agriculture

List of Available publications
- Bureau of Agricultural Economics—Reports and Publications
- Agricultural Statistics (annual)
- Naval Stores Report (quarterly)

Tariff Commission

Synthetic Organic Chemicals, U. S. Production and Sales (annual). Includes directory of producers of 4,500 chemicals.

Facts for Industry Series 6-2. Synthetic Organic Chemicals (monthly).

Subject index of tariff commission publications.

Bureau of Mines

Minerals Yearbook (annual).

Monthly statistical statements (cement, petroleum, coke, etc.).

Production of Explosives in the U. S. (annual).

List of publications of the Bureau of Mines.

Trade Journal Articles

Conklin, M. R., *Industrial Marketing* 30, No. 10, 98 (Act. 1945) "Census of Manufactures to be Restored in 1946"

Van Swearingen, J. A., *Chem. & Met.*, Jan. 1946 "Chemical Marketing Statistics Program of the Bureau of the Census."

Chemical & Metallurgical Engineering

Annual statistical issues, monthly chemical economics section and check lists of government publications.

Reprints of this report are available at 25 cents per copy. Address the Editorial Department, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

HYDROGEN

IN A TYPICAL Hygirtol plant as designed and built by the Girdler Corp. for the production of high-purity hydrogen from hydrocarbons and steam, propane from a pressure storage tank flows through caustic and water scrubbers for the removal of sulphur compounds, then is mixed with steam, and passes through the hydrogen furnace where the propane and steam react at about 1,500 deg. F. over a nickel catalyst to produce carbon oxides and hydrogen. On the furnace outlet, more steam is added to cool the gas to about 750 deg. F., after which the mixture passes through the first stage carbon monoxide converter where the greater part of the carbon monoxide is oxidized to carbon dioxide. Leaving the converter, the gas passes through a heat exchanger and cooler, and then enters the first stage carbon dioxide absorber where a stream of monoethanolamine solution removes the carbon dioxide from the gas. On the absorber outlet, steam is mixed with the gas, and the mixture passes through the heat exchanger, where it is heated and then flows to the second stage carbon monoxide converter for further carbon monoxide oxidation.

The purification of the hydrogen is completed by carbon dioxide removal, followed by another stage of carbon monoxide oxidation and carbon dioxide removal. The removal of carbon dioxide is effected by the same solution flowing through all three absorbers in series in reverse order to the gas flow and then being regenerated continuously by boiling and steam stripping.

The purified hydrogen is more than 99.9 percent pure, with less than 0.01 percent of carbon monoxide or carbon dioxide, and less than 0.1 percent residual hydrocarbon.

The operation of a plant is continuous, and requires only part-time supervision by an operator. In some cases the carbon dioxide removal equipment has been housed, although outdoor installation such as that pictured here are in more general use.

Pure carbon dioxide is obtained as a by-product in Hygirtol plant operation. This amounts to 35 lb. of carbon dioxide per thousand cubic feet of hydrogen produced. By the addition of scrubbing and compression equipment liquid carbon dioxide may be recovered for sale or use. The carbon dioxide gas produced by the plant is also suitable for purging and blanketing operations.

For a more detailed article and additional pictures of this process refer to pages 122-3 of this issue.

CHEMICAL & METALLURGICAL ENGINEERING

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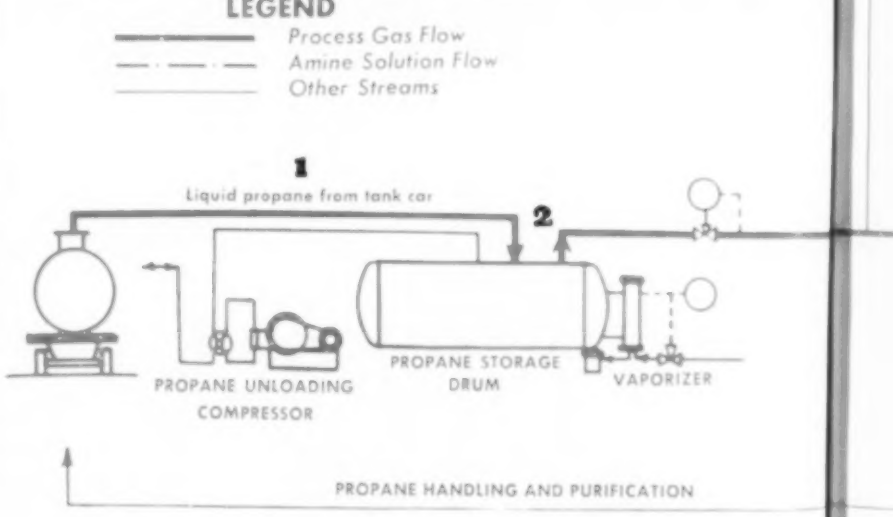
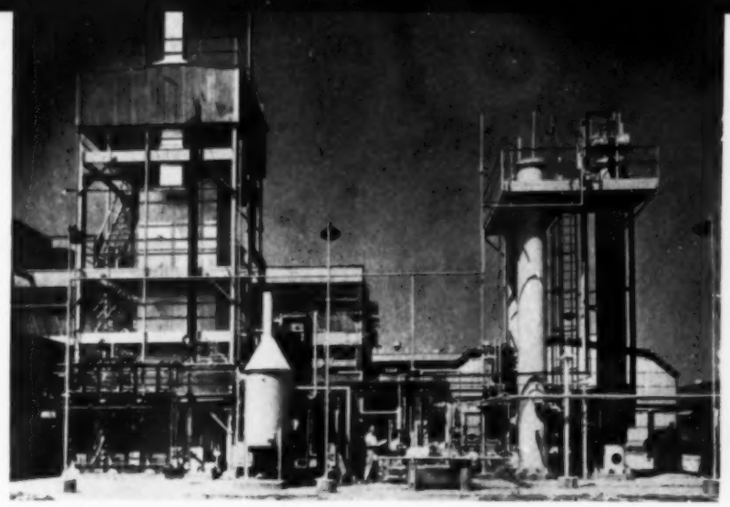
PAGES 162 TO 165

This typical Hygirtol plant for production of hydrogen from propane and steam combines several established processes

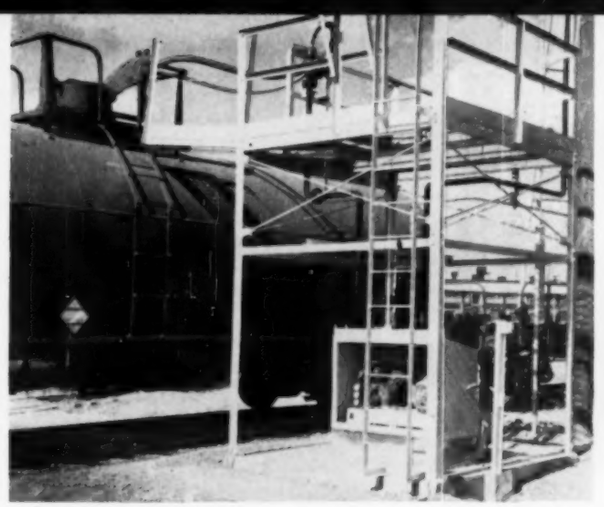


Material and Utility Requirements per 1000 cu. ft. of Hydrogen

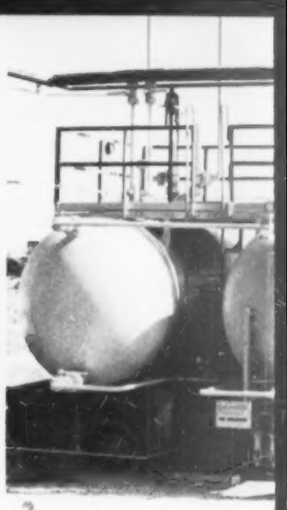
Material	Quantity
Process material,	
Propane, gal.	2.75
or	
Natural gas, cu. ft.	250
Fuel (gas or oil) B.t.u.	250,000
Steam, lb.	330
Cooling water, gal. (30 deg. F. rise)	1,600
Power, kwh.	2
Chemicals, cost in cents	2



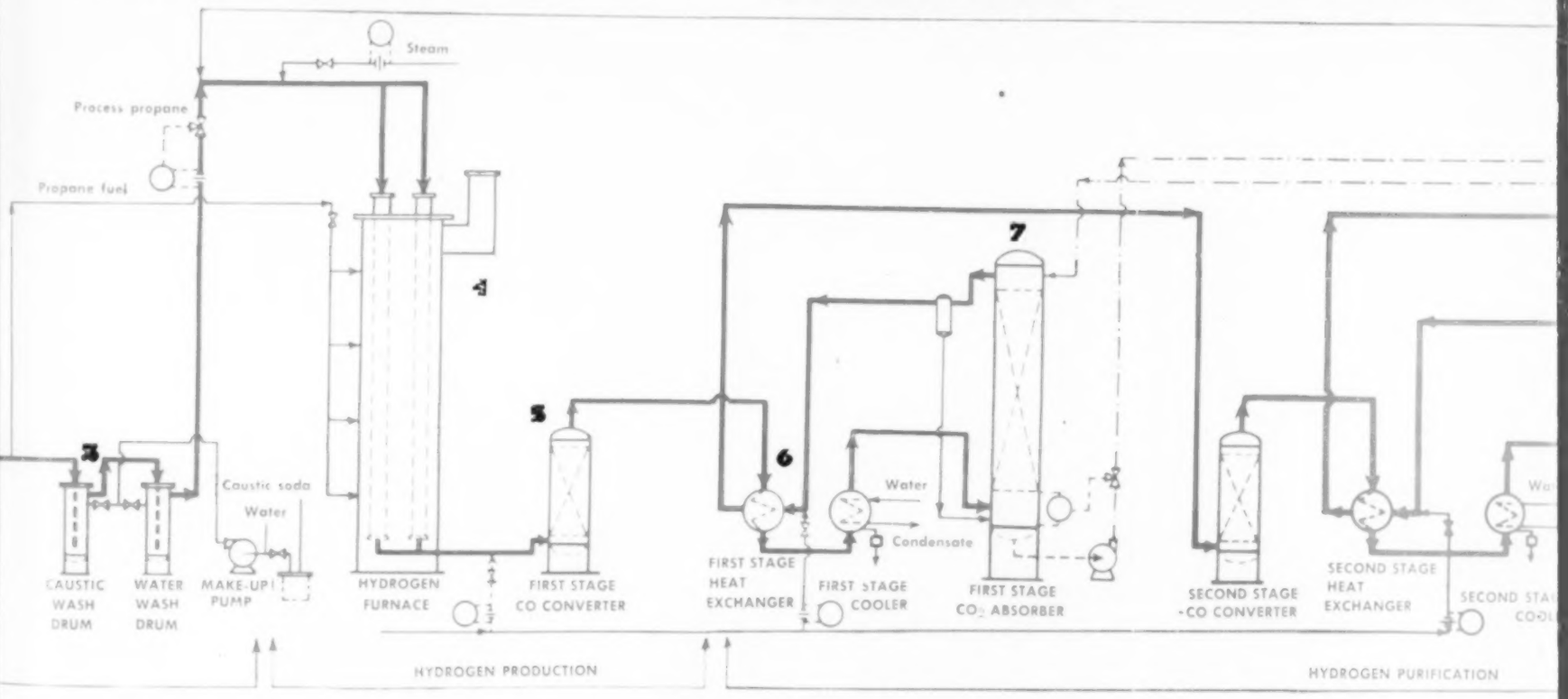
Rear view of the plant showing hydrogen furnace at left and carbon dioxide absorbers and reactivators at right



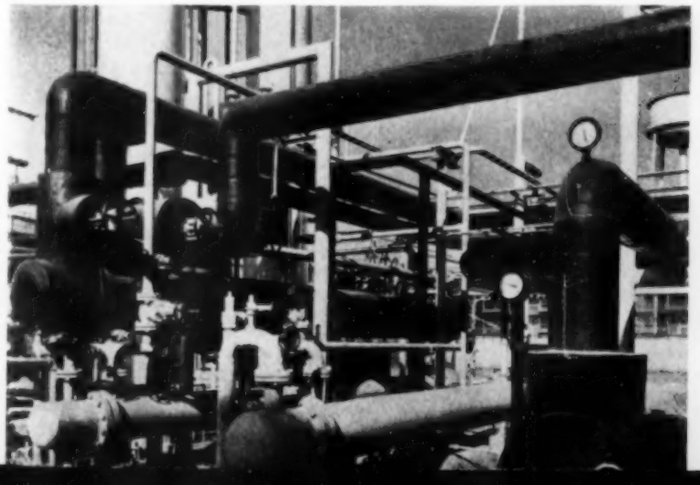
1 Hydrogen is made from propane and steam. The propane is unloaded here from a tank car



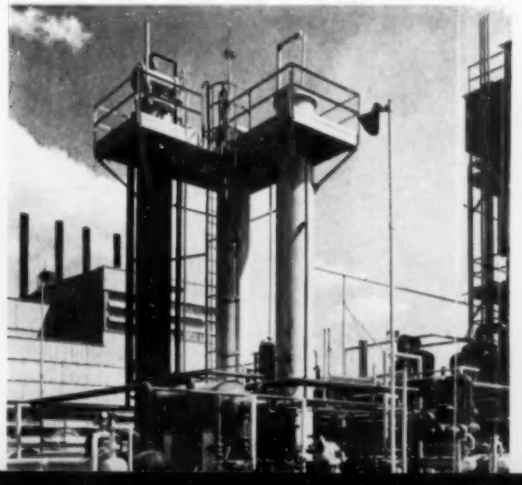
2 From the tank car uni
pair of horizontal pressur



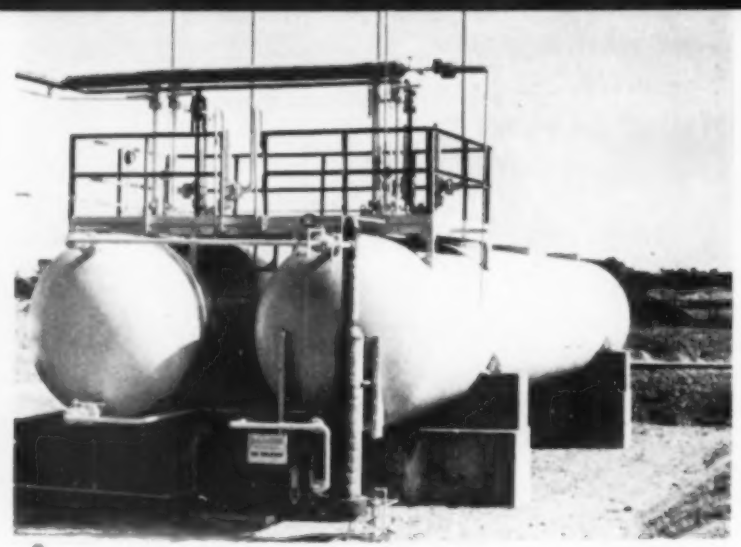
6 Leaving converter gas passes through a heat exchanger and cooler; first and second stages are shown



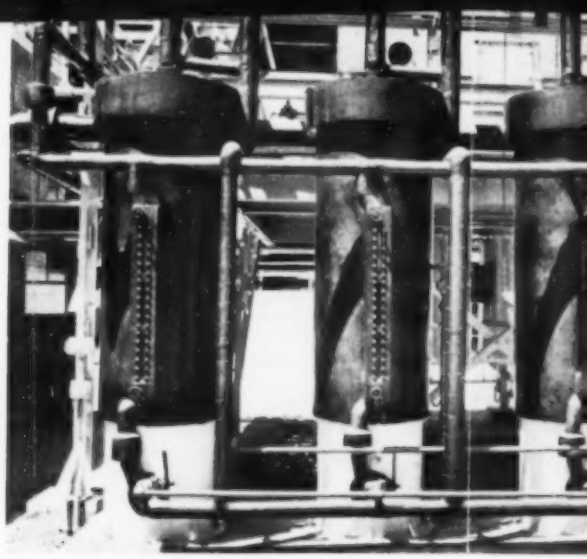
7 The gas enters the first stage carbon dioxide absorber and later a second stage



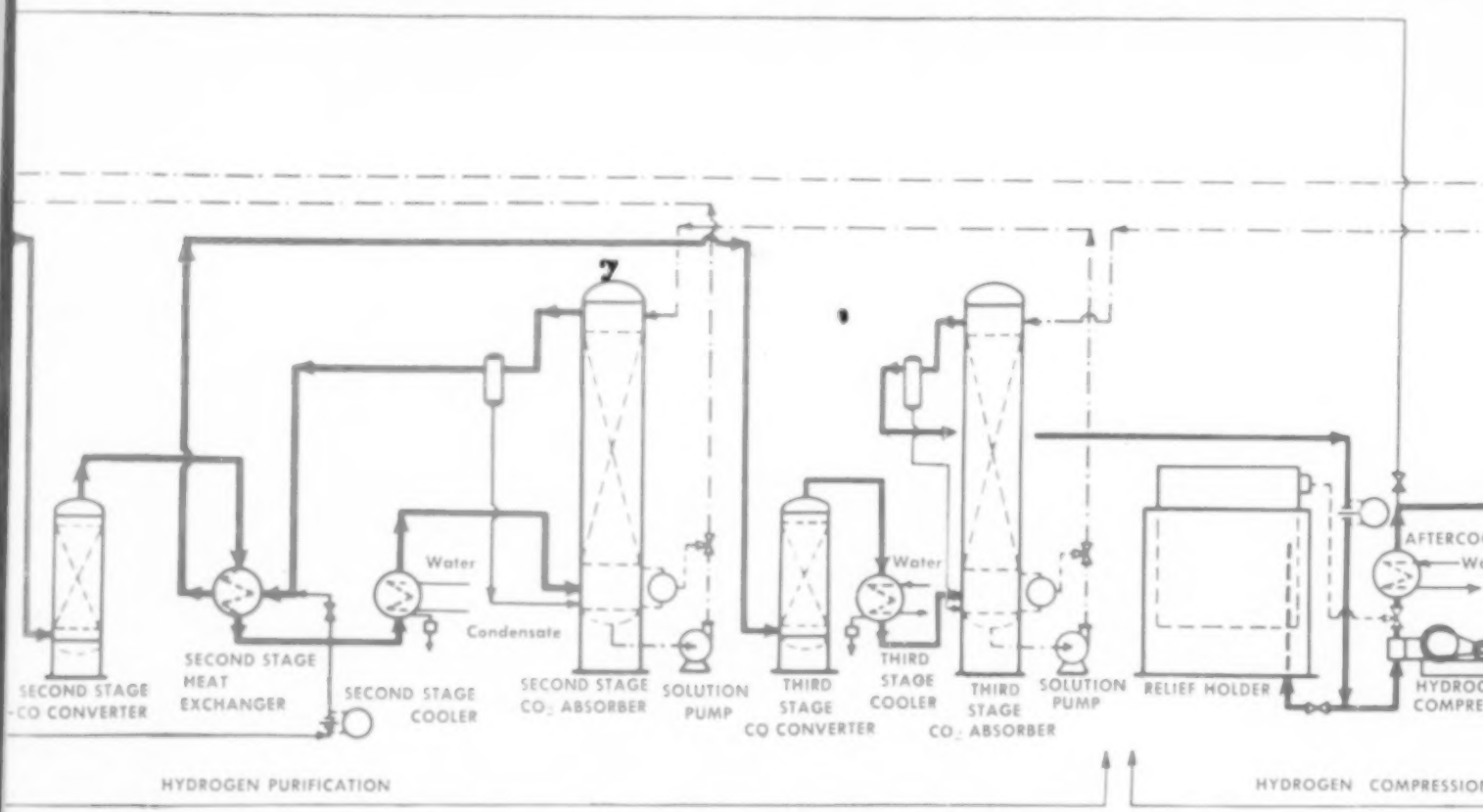
8 Monoethanolamine solution ren
Heat exchanger and cooler for am



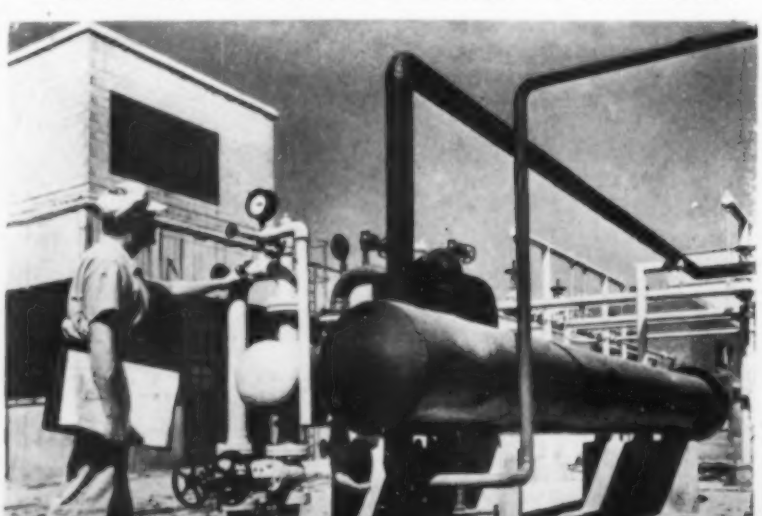
2 From the tank car unloading rack propane is pumped to a pair of horizontal pressure tanks for storage.



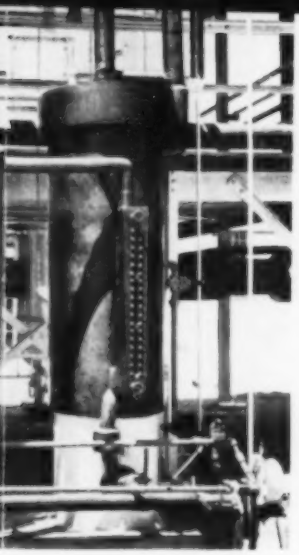
3 Propane from the storage tanks flows through caust scrubbers in which the sulphur compounds are remove



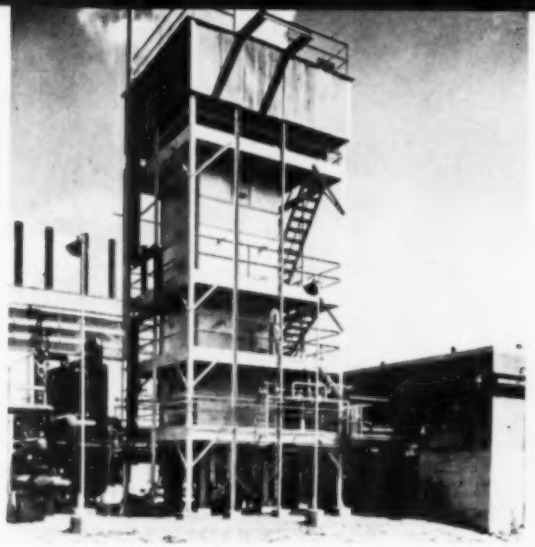
8 Monoethanolamine solution removes carbon dioxide from gas. Heat exchanger and cooler for amine solution are being inspected



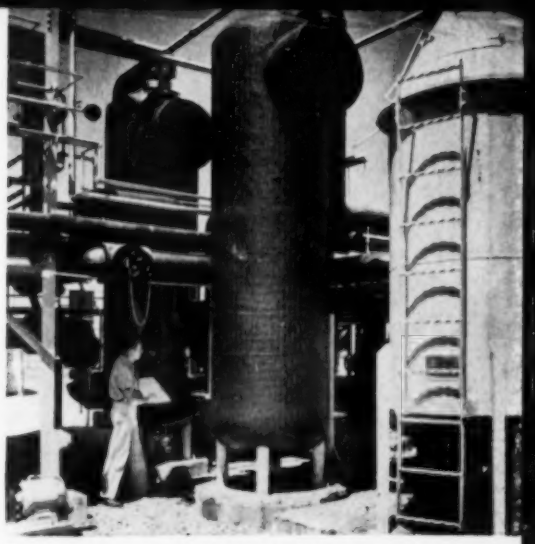
9 The amine solution used for the removal of carbon from the gas is circulated by means of these pumps



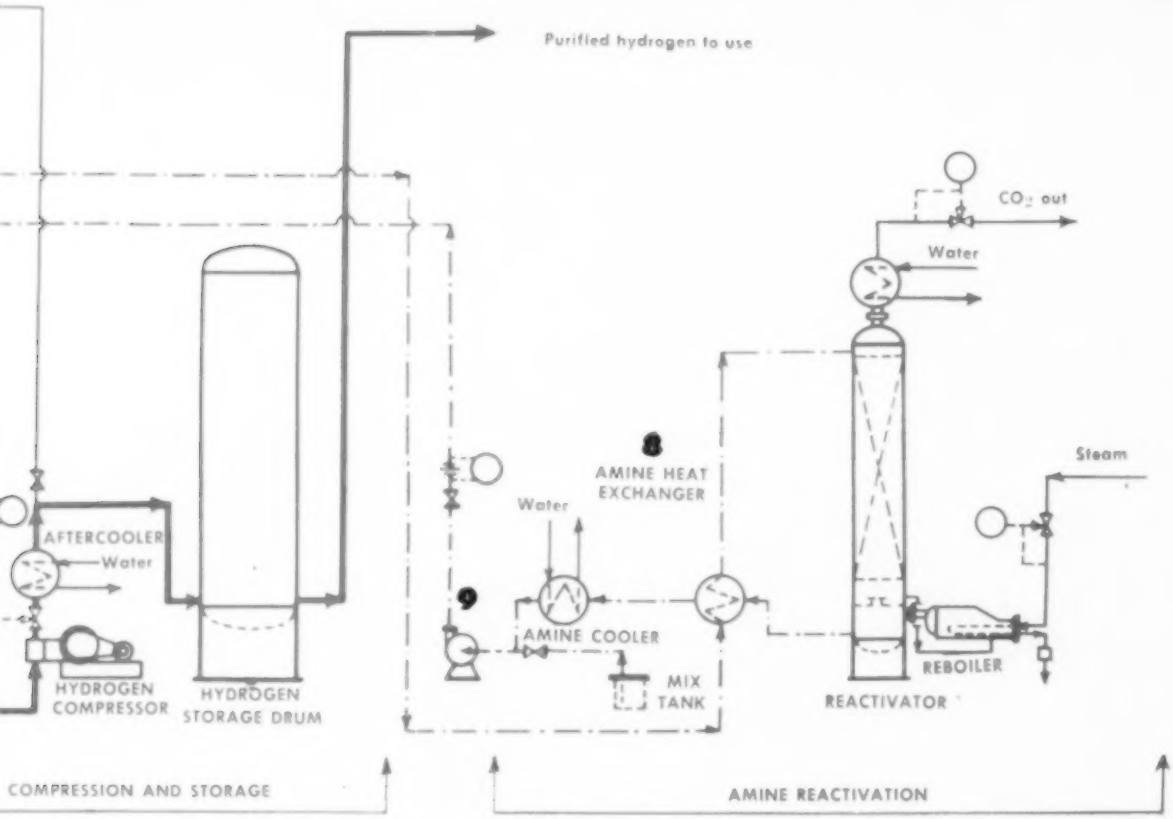
rough caustic and water
are removed



4 In the hydrogen furnace propane and steam are converted to carbon oxides and hydrogen

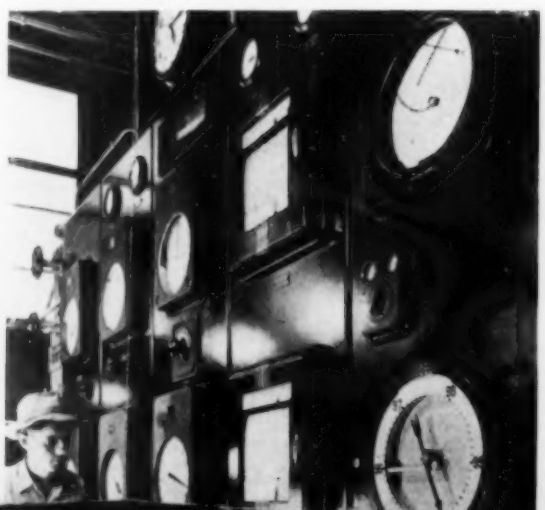


5 Mixtures pass through first and second stage monoxide converters



of carbon dioxide
e pumps

Instrument control panel for the plant. Photographs by Robert Yarnall Richie



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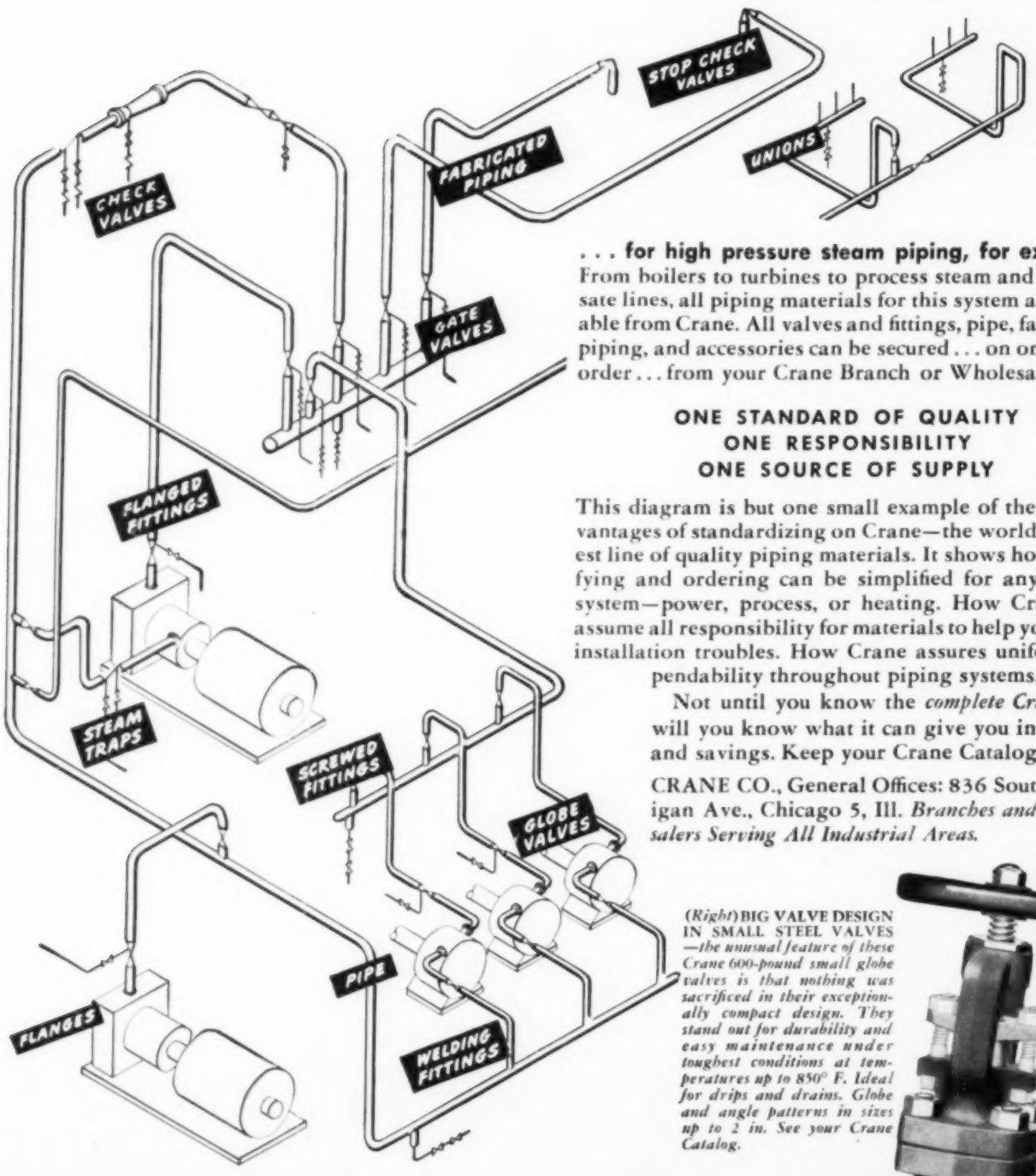

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NEW PRODUCTS AND MATERIALS

R. W. PORTER, Assistant Editor

CONTENTS

TEXTILE RESINS

Two RESINS for treating fabrics have been recently announced by the United States Rubber Co., Rockefeller Center, New York, N. Y. One of these, which imparts a crispness to cotton fabrics, eliminating the necessity for starch in cotton garments, is commercially available under the brand name of Candar. This new resin is applied at the time of finishing the textile material. This finish is claimed not to wash out of the fabric, despite repeated laundering and dry cleaning, but is retained by the material to restore its newness and crispness after each washing and ironing. It may also be used on rayon fabrics to give them better drape and fullness. The second of these resins, called Vibrin, is a contact resin for laminating with glass or textile fabrics at low temperature and pressure.

ANTI-FOAM AGENT

ANOTHER silicone product has been recently developed by the Dow-Corning Corp., Midland, Mich., for use as foam preventive. Known as DC Anti-Foam A, this material is said to be effective in the elimination of many foaming problems. It is effective in low concentrations ranging from one part in ten thousand against strong foamers to one part in one million against weak foamers. This silicone anti-foam agent is a viscous compound which is transluscent, colorless and tasteless. It is chemically inert, nonvolatile, and has a slight odor. It is insoluble in water or alcohol, and is dispersible in such solvents as benzene, carbon tetrachloride, toluene, and naphtha. It may be used as supplied or it may be thinned with one of the above solvents or made into emulsion. DC Anti-Foam A is claimed to be effective against foaming in alkaline black liquor, rosin soap solutions, sodium oleate and sodium alkyl sulphate solutions, Aerosol O.T. cutting oil emulsion, egg albumen, and various synthetic rubber latices. No claims have been made that this anti-foam agent will be effective in a given situation without experimentation. But, the expectation that DC Anti-Foam A will prevent foam in situations similar to those described above is claimed to be good. It is available in 1, 10 and 50-lb. cans.

PARAFFIN HYDROCARBON

Now AVAILABLE at comparatively low prices in drum or tank car quantities, high purity normal heptane has been announced by the chemical products department of Phillips Petroleum Co., Bartlesville, Okla. This material is said to have a purity of over 99 mol percent with a boiling point of 209 deg. F., a freezing point of —90.76 deg. C., and a density of 0.6839 g. per ml. Impurities in this material consist mainly of traces of 3-methylhexane, methylcyclohexane or both. It is suggested for use as a solvent.

ALUMINUM ASPHALT PAINT

AN INSULATING coating in which the heat and light reflecting value of aluminum is combined with the protective qualities of mineral asphalt is now commercially available from Service Industries, Chemical Products Division, 2103 E. Somerset St., Philadelphia 34, Pa. Known as Sil-Var, this material can be applied by brushing, dipping or spraying to form a coating which is said to be proof against acid, alkali, corrosive fumes, and water. It may be used to protect wood, masonry, and metal structures, as well as felt and composition roofs. When Sil-Var is applied, the aluminum forms continuously over the entire surface where it remains permanently bound to the black asphalt coating underneath. This forms a laminated coating of mineral asphalt and non-ferrous metal which provides protection and insulation. The coverage of Sil-Var runs from 750 to 1,000 sq.ft. per gal. Where this material is to be applied to surfaces which may come in contact with oil, grease or gasoline, it is made up with a special bitumen base that is inert to these materials. It is available in quantities of 1, 5, 32½ and 65 gal.

PLASTIC ACCELERATOR

A HIGH speed catalyst for use in thermosetting plastic castings has been developed by Duorite Plastic Industries, Culver City, Calif. Known as Accelerator No. 70, it was designed to use with phenolic resin and, according to claims made, will cut down the time of hardening to 20 minutes or less. Previous methods took from six to eight hours to cure phenolic resin. It cannot be satisfactorily used to produce translucent or transparent castings. It has a low-corrosive acid base combined with a plasticizer which acts as a buffer for exothermal heat. The buffing action of the plasticizer keeps the acid from harming the active resin in the process of curing. When first mixed with the resin the catalyst has a tendency to thin the mixture permitting the elimination of air bubbles produced during molding. Hardening takes place only after the plastic mold is placed in a curing oven. It is suitable for use with resins containing both pigments and fillers.

RUBBER POLYMER

A MODIFIED GR-S polymer known as X-285 is now available for experimental use from the United States Rubber Company, Naugatuck, Conn. This new polymer permits the manufacture of hose and rubber articles having very low shrinkage during compounding. GR-S is modified by certain chemicals which serve to tie the growing polymer chains together into a network or gel. This gel structure is responsible for reducing shrinkage which makes possible the smooth surfaces of finished stock. Ordinarily calender stocks of raw GR-S give as much as 50 percent shrinkage and are very rough. Samples extruded through a die swell excessively and have wavy and broken edges. Use of the new polymer eliminates these disadvantages according to the manufacturer. Shrinkage is eliminated to the extent that with only 0.5 percent of the modifying agent, calendar stocks remained almost as smooth as the calender rolls. X-285 can be used to best advantage in blends with standard GR-S in various

proportions, depending upon the particular properties desired. Deterioration of some physical properties accompanying the use of X-285, is compensated for by the GR-S component. Suggested applications of this new synthetic rubber include calendered articles such as sheeting and rubber footwear, insulation for wire, and other similar applications.

DEODORANT

EFFECTIVE as a deodorizer and germicide, Ke-Cide, an odorless disinfectant, was recently announced by the Kelite Products, Inc., Los Angeles, Calif. Ke-Cide is a powder material which is used by dissolving in water. At the recommended concentration it is non-corrosive, non-toxic and non-irritating. Having a 4.4 phenol coefficient, it is high in germ killing power, losing little of its effect when exposed to the air, insuring long-lasting germicidal potency. Its detergent qualities aid it to maintain sanitary standards in various industries. It has no odor of its own and does not replace one odor with another Ke-Cide should find wide use in deodorizing in lavatories, locker rooms, and other public places. It is available in 325-, 125- and 60-lb. quantities, as well as in 5-lb. packages.

LUMINESCENT LUCITE

NEW FORMS of acrylic resins containing luminescent pigments which glow when exposed to ultraviolet, and another type which glows in the dark after exposure to ordinary light have been announced by the Plastics Department of the E. I. du Pont de Nemours & Co. Inc., Wilmington, Del. This form of lucite is available in sheets and can be manufactured in a wide range of colors, in all standard sizes of regular lucite sheeting. The resin contains luminescent pigments based on phosphorus.

SCALE PREVENTIVE

USED TO prevent deposition of lime scale on condenser surfaces of refrigeration and air conditioning units, Micromet, a modification of the chemical Calgon, is manufactured by Calgon, Inc., Pittsburgh, Pa. The make-up water for condensers is passed through a bed of Micromet, dissolving a very small amount (about 5 p.p.m.) which prevents scale formation. Micromet is a slowly-soluble phosphate glass made from high grade phosphoric acid. While it is not a cure-all it has rated high in a number of tests.

RUBBERLIKE PLASTIC

USED in place of materials such as plaster and glue gelatin for the fabrication of molds necessary in casting other plastics, plaster, and similar products, a new rubberlike plastic under the brand name of Duroflex is now being produced by Duorite Plastic Industries, Culver City, Calif. This material can be bounced and stretched like rubber, but cannot be vulcanized. Plastic molds, which are widely used for casting purposes, have a number of disadvantages which are claimed to be overcome by the use of Duroflex. One-piece Duroflex molds can be used to produce articles with all types of back drafts or undercuts because they can be stretched when it is necessary to remove castings. Casting molds require no lacquers or wax parting agents, because this new material is non-porous and has a texture which duplicates the contours of a model or pattern with good accuracy. It is claimed that water, acid and other corrosive chemicals such as are normally utilized in casting plastics have no immediate effect on this plastic elastomer. Tests have shown that Duroflex molds can withstand temperatures of as much as 225 deg. F. without being affected. Other possible uses for this material include strip coating and for use as molding compounds in the production of soft, rubberlike articles.

GRINDING FLUID

KNOWN AS Microgrind 70, a new water soluble grinding fluid has been announced by Quaker Chemical Products Corp., Conshohocken, Pa. It is employed on abrasive operations on all types of steel and most other metals. It is claimed that this fluid will not develop rancidity or odors, and can be used for three months or longer without change if makeup is added periodically. Microgrind 70 is a practically odorless, pink-colored, low viscosity liquid which quickly dissolves in water of all hardnesses. It has a detergent action on abrasive wheels which causes them to be kept open and free cutting. When used with the Quaker Microgrind process, it is claimed to have various advantages such as: Virtual elimination of cracks, burns and distortion due to grinding; greatly increased wheel life; much less frequent wheel dressing, with consequent savings in dressing costs; production of finer ground finishes; increased production with frequent elimination of a roughing or lapping operation.

FATTY ACID

NOW AVAILABLE in commercial quantities, Palmalene, a new synthetic fatty acid, has been announced by the Beacon Co., 97 Bickford St., Boston, Mass. It has a saponification number of 180-185, iodine value of 55-60, and titre of 30. It is suggested for use in the manufacture of textile specialties, soaps, alkyl resins, polishes, wetting agents, cosmetics, and a number of other similar applications.

ELASTIC NYLON

DEVELOPED on an experimental scale by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., elastic nylon has properties approaching those of rubber. Textile fibres made from certain of these new nylons which are N-substituted polyamides have good elastic properties. Certain types of these materials can be stretched 250 to 400 percent in comparison with 600 to 1,100 percent for rubber. The elastic recovery of this nylon is from 95 to 99 percent in comparison with 100 percent for rubber. Elastic nylon is not available at the present time.

SYNTHETIC RESIN

DEVELOPED to replace Pliolite, a new synthetic copolymer resin has been announced by the Goodyear Tire & Rubber Co., Akron, Ohio. The wartime shortage of natural rubber which prevented the manufacture of the original Pliolite, a vehicle for paints, led to this development. The new material, designated as Pliolite S-5, is a thermoplastic, non-oxidizing, synthetic copolymer resin made from readily available raw materials. It is resistant to moisture, acids, alkalids, and other chemicals and has the properties necessary for use in fast drying protective coatings. Suggested uses are for acid and alkali resistant coatings, concrete floor enamels, architectural finishes, trims, floor paints, metal primers and finishes, oil and grease resistant coatings, baking enamels, corrosion resistant coatings, water tubs, ship bottoms, and a number of other uses. Pliolite S-5 is soluble in aromatic hydrocarbons solutions of what will tolerate considerable dilution with cheap petroleum thinners without separation or precipitation of pigments. It has low solvent retention, permitting the solvent to evaporate quickly, bringing about quick drying, and dries by evaporation rather than oxidation. It is claimed to have high resistance to abrasion, good aging characteristics, thermal stability, is non-toxic, has good color and clarity. It is available either in the milled or unmilled form.

TEXTILE FUNGICIDE

WARTIME investigation in the field of textile preservatives by the Monsanto Chemical Co., St. Louis, Mo., resulted in the discovery that copper 8-quinolinolate when properly formulated and applied to textile fabrics provides protection against various types of fungi and organisms. Designated as Milmer, this compound is sometimes referred to as the copper salt of 8-hydroxyquinoline, which chemical has been known since 1880 in Germany. This preservative is used for mill application only and textiles treated with it are colored a light stable greenish-yellow shade. Where darker shades are desired the color of the preservative can be readily masked. It has been tested against a wide variety of different types of organisms which ordinarily destroy textile fabrics. When properly formulated and applied, the fungicide is claimed to impart all of the preservative qualities required for textile materials which come into contact with earth and dampness. This preservative treatment adds long life to such items as fish nets and lines, cordage, tents, tarpaulins, awnings, upholstery materials, shoeliners, and other similar items. It is relatively non-toxic to humans and does not irritate the skin.

ENGINE CLEANER

TWO NEW solvents for cleaning engines have been announced by the Standard Oil Co. of Ind., 910 S. Michigan Ave., Chicago, Ill. Stano-purge is used for cleaning crankcases and lubrication systems of engines and will remove loose crankcase sludge and clean oil screens and oil pipes. The second product Stano-vim is used for purging fuel-burning systems, removing varnish, gum and carbon deposits from valve stems, manifold and intake valve parts. Both of these products have high solvency for resins and gums formed by deterioration of motor oil. They have low volatility and high flash points.

LUBRICANT

A GENERAL-PURPOSE aircraft grease which is claimed to provide satisfactory lubrication between temperature ranges of −40 deg. F. and +250 deg. F. has been announced by

The Texas Co., 135 East 42nd St., New York, N. Y. Its brand name is Regal Starfak Special. Originally designed to meet Army and Navy requirements, the lubricant is now being rapidly adopted for use in commercial transports. It is used in such widely varied applications as landing gears, wheel bearings, control bearings, propeller hubs and many other aircraft services. Representative tests on this lubricant are given in the accompanying table.

Properties of Regal Starfak Special

Penetration at 77 deg. F., worked (ASTM)	260
Water (by dist.), percent	0.1
Dropping point (ASTM), deg. F.	308
Sodium soap, percent	13.7
Calcium soap, percent	2.8
Free alkali, ASTM, percent	None
Free fatty acid, ASTM, percent	0.06
Mineral oil, percent	83.4
Tests on oil:	
Gravity, deg. API	31.3
Flash, deg. F.	400
Fire, deg. F.	460
Viscosity at 100 deg. F., S.U.	168
Viscosity, index	97
Pour, deg. F.	−10

2-BROMOTHIOPHENE

COMMERCIAL production of 2-bromothiophene has recently been announced by the Michigan Chemical Corp., St. Louis, Mich. It is claimed to have important value as an intermediate in the synthesis of therapeutically active compounds. Replacement of a benzene ring in such compounds by 2-bromothiophene has been found to result in an increase in therapeutic activity.

SALT TABLETS

DEVELOPED to prevent stomach irritations from salt tablets used by personnel during conditions of excessive heat, a new coated tablet is now available from the U. S. Safety Service Co., 1215 McGee St., Kansas City 6, Mo., under the trade name of Pep-Up Salt Tablets. This coated tablet does not dissolve until it gets to the small intestine. It is claimed to prevent nausea often caused by ordinary salt tablets.

AMINE

Now COMMERCIALLY available from Sharples Chemicals, Inc., 123 S. Broad St., Philadelphia 9, Pa., is isopropylamine. This material, an aliphatic amine undergoes the wide variety of reactions typical of its class and offers possibilities as an intermediate and solvent. It is of interest in the synthesis of many products including pharmaceuticals, insecticides, photographic chemicals, rubber chemicals, dyestuffs and textile assistants.

WOOL DYEING DETERGENT

USED in the dyeing of wool, a combination detergent, leveling agent, and protective agent has been developed by the textile chemical division of the Dexter Chemical Corp., 819 Edgewater Road, New York 59, N. Y. Designated as Telkanol O Solution, this chemical is claimed to be stable toward all kinds of conditions occurring in the processing of wool, including boiling acid liquors. It is said to be unaffected by the hardness of water, acid, alkalis, salts, and may be used for machine dyeing. It is claimed to have a strong dispersing effect upon oil, grease, or other impurities in the wool and upon all kinds of fats in the acid liquors. By boiling in a solution of Telkanol, dilute acetic acid, and water, followed by a thorough rinsing, wool waste with a high grease or mineral oil content can be degreased to such an extent

that no difficulties will arise in subsequent dyeing. It is said to have been successfully used for the dissolving and dyeing of dyestuffs which, because of limited solubility, give trouble in leveling, and it is recommended for use in acid dye baths. As little as ½ to 1½ percent Telkanol O solution is found helpful as a leveling agent and auxiliary to obtain better fastness to rubbing and a more even dyeing of clearer shades. It is said to be useful in the dyeing of mixed wool and cotton, or mixed wool and spun rayon where it has proved valuable as a protective agent against precipitation of direct dyestuff sensitive to lime. It may also be used for dyeing loose fur.

VINYL FILM

DEVELOPMENT of a new unsupported vinyl plastic film known as Pantex has been announced by the Pantasote Co., Passaic, N. J. This material has been successfully embossed in a variety of natural grainings. The absence of supporting fabrics or paper contributes greatly to the softness of hand and freedom from surface roughness arising from unevenness of base. Ease of cutting, tailoring and fabricating makes possible many unusual and intricate designs. Although primarily developed for use in women's shoes, handbags, belts, etc. Pantex is now being used in upholstery, decorative wall coverings, brief cases, desk sets and similar items.

SHRINKPROOF WOOL

CHEMICALLY treated wool fiber which resists shrinkage and which imparts to wool fabric smoothness and flatness has been announced by the Monsanto Chemical Co., St. Louis, Mo. Wool fibers are impregnated with Resloom, a melamine formaldehyde resin which imparts shrinkage control, stability, wrinkle-resistance and crease retention. It can be applied on existing mill equipment and does not change the feel and the appearance of the textile material. While the physical properties of wool are improved, it is believed that the chemical composition appears to be wholly dissimilar to that of natural wool. The actual chemistry of this new treatment has not been studied completely. It is claimed that it will modify woolen fabrics and improve the porosity, flatness and thinness required for summer clothing. It is also claimed that a Resloom treated wool flannel shirt shrank less than 1½ percent after five soap and water launderings in contrast with 50 percent for untreated wool. The fabric is not expected to reach the market until 1947.

RESIN SURFACE COATING

DEVELOPED as a surfacing agent for application on porous bodies such as concrete, wood, composition board, plastic, etc., a high-solid content resin coating has been announced by the Furane Plastics & Chemicals Co., 4500 Brazil Street & San Fernando Road, Los Angeles 26, Calif. This liquid resin having unusually good gap-filling qualities is activated with a small amount of catalyst after which it is spread upon various types of surfaces. Because of its solid content, surface imperfections and defects in wood, concrete, etc. will be concealed. The coating will dry to the touch in approximately one-half hour after application and will set hard overnight. This new

uniformity makes the big difference

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surface coating is characterized by the following: (1) It is substantially complete resinous coating with negligible volatile material present, (2) it is a thermosetting plastic capable of drying in air within a few hours, (3) heavy deposits may be laid on in one brush coat, tending to hide surface defects, scars and scratches on relatively porous materials, (4) it has complete chemical inertness to acids, alkalis, solvents and water, (5) it provides a black, high gloss coating which will stand much weathering. Suggested applications include finishing and sealer coats for wood patterns, coating agents for laboratory table tops, such as Masonite, impervious water-repellent coatings for wood, ceramics, wall board, etc.

PACKAGING MATERIAL

ANOTHER member of the Pliofilm family known as FF Pliofilm is claimed to be easily adapted to caps for frozen foods according to the Goodyear Tire & Rubber Company, Akron, Ohio. It remains flexible at —20 deg. F. and possesses the same heat-treating sealing qualities of conventional Pliofilm and in addition can be sealed against frozen products. Moisture transmission at this low temperature is practically eliminated according to the manufacturer. It is planned to supply locker plants, and home users of freezer units with this type of Pliofilm in rolls of convenient width for packaging meat and poultry and as carton liners for packaging loose foods to be frozen.

FABRIC FINISH

RECENTLY developed by the American Cyanamid Co., Bound Brook, N. J., a new resin finish is now available for use on sheer fabrics for apparel and home furnishings. Under the brand name of Sheerset, this resin is a melamine compound which is claimed to eliminate the tendency of sheer fabrics to wilt, lose their shape, and lose their crispness when wet and after washing. It can only be applied at textile mills and is said to aid in the control of shrinking and stretching, as well as to impart a permanent crispness. It was developed during the war for use on nylon and cotton inset nettings used in the Pacific theater where extreme humidity and steady rainfalls prevailed. It is expected to find wide use on such fabrics as organdy, voile, net, lace, dotted swiss, marquisette, etc.

COLD STARTING FUEL

A COLD starting fuel for aircraft operating in sub-zero temperatures has recently been announced by the Texas Co., 135 E. 42nd St., New York, N. Y. This fuel is designed to replace high octane gasolines for only the brief interval required to start the engine. Use of this fuel, which is made up of low boiling point fractions and is liquid at all atmospheric temperatures and pressures, cuts down the starting and warming up time normally required in sub-zero climates. It is carried in a portable external tank which may be disconnected by the ground crew after starting. This fuel cannot be used during flight because of the danger of vapor locking.

RESIN GLUE

RESULTING from a wide number of experiments with various materials, Paisley Products, Inc., 1770 Canalport Avenue, Chi-

HOW A ST. REGIS PACKAGING SYSTEM SAVES MONEY

for a manufacturer having limited* production

This fifth case history in a series of MULTIWALL success stories, relates the savings effected by a cocoa manufacturing concern through the introduction of St. Regis Multiwall Paper Valve Bags and Machine Packaging. Prior to the installation of the St. Regis Packaging System this company used various types of packages . . . barrels, fibre drums, and open-mouth burlap bags with paper liners. Since their initial trial, about one year ago, St. Regis Multiwall Paper Valve Bags have been found to be the most efficient and economical container for the purposes of this company.

REDUCED LABOR COSTS: Prior to adopting the St. Regis Packaging System this company was using one man to fill the bags, one to weigh them, and one to sew them closed. Now, one operator can fill and check-weigh 25 more 100-lb. bags per hour than the former three man crew . . . a labor saving of 66⅔% in filling and weighing.

INCREASED PRODUCTION: The original three man filling crew and a three man handling crew were able to handle only 4000-lbs. of cocoa per hour. Since the installation of the St. Regis Packaging System one man is able to supply the three-man handling crew with 6500-lbs. of cocoa for shipment to customers . . . an increase in production of 62½% over the old system.

AN EXAMPLE IN PACKAGING ARITHMETIC

QUESTION:

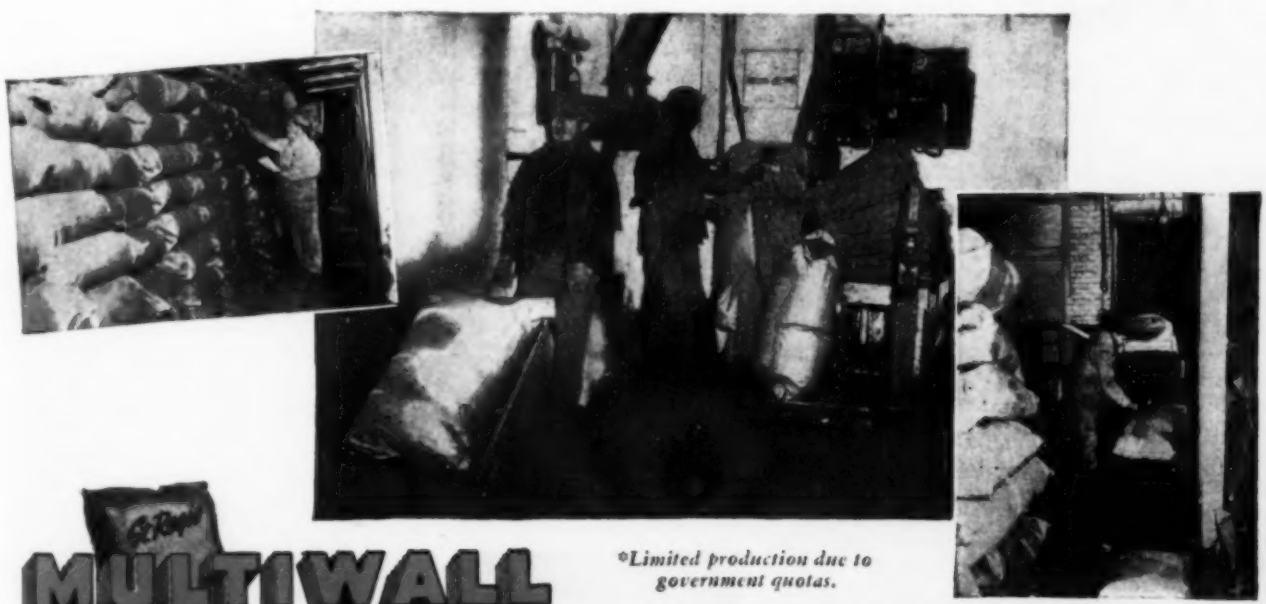
If it took three men one hour to fill, weigh and close 4000-lbs. of cocoa . . . how can one man fill, check-weigh and close 6500-lbs. in an hour?

ANSWER:

By changing over to a St. Regis Packaging System using a St. Regis Valve Bag Packer to fill Multiwall Paper Valve Bags.

REDUCED CONTAINER COSTS: In addition to the product protection afforded by multiple walls of kraft paper and the greater ease of handling Multiwalls, the customer discovered a saving of over 55% in bag cost by using Multiwall Paper Bags instead of Burlap Bags with paper liners.

The figures in this example prove conclusively that St. Regis Packaging Systems are just as applicable to small packaging operations as they are to operations that require batteries of high-speed packers. Call in a St. Regis field representative to advise you on the type packer that will best suit your needs.



MULTIWALL

*Limited production due to government quotas.

ST. REGIS SALES CORPORATION

(Sales Subsidiary of St. Regis Paper Company)

NEW YORK 17: 230 Park Ave. CHICAGO 1: 230 No. Michigan Ave.
BALTIMORE 2: 2601 O'Sullivan Bldg. SAN FRANCISCO 4: 1 Montgomery St.

Mail this coupon for the complete story

Birmingham Boston Cleveland Dallas Denver Detroit
Franklin, Va. Los Angeles Nazareth, Pa. New Orleans
No. Kansas City, Mo. Ocala, Fla. Oswego, N. Y. Seattle Toledo

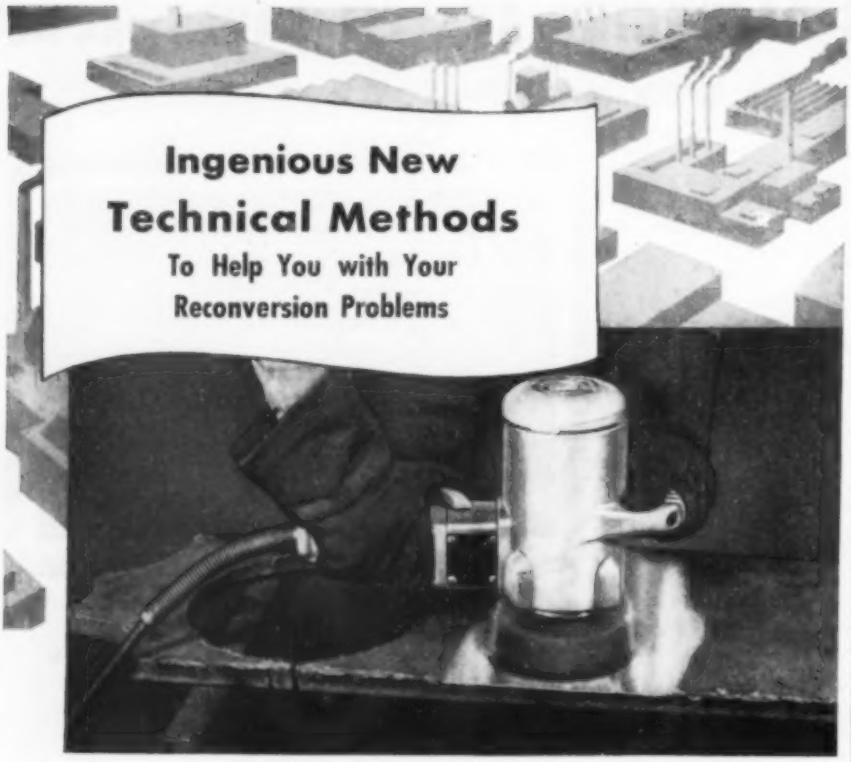
IN CANADA: St. Regis Paper Co. (Can.) Ltd., Montreal, Vancouver.

Without obligation, please send me full details regarding "Case History" No. 5, outlined above.

NAME_____

COMPANY_____

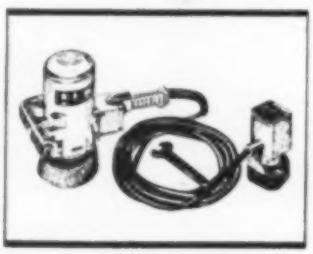
ADDRESS_____



New Portable Grinder Lasts Longer . . . Increases Production

The Portable Gaston Grinder is designed for the grinding and sanding of metal—also, with wire brushes, for paint and rust removal. Because it is powered by a 3-phase motor, without brushes, commutators or gears, the Gaston will give long service.

The Gaston Grinder starts at full speed. Its speed remains constant regardless of extra pressure by the operator. This controlled speed under heavy load, eliminates glazing of the grinding wheel; produces a better ground surface.



The Portable Gaston Grinder

Three sizes of dust-tight Gaston Grinders are available. Furnished in either "cup-wheel" or "edge-wheel" type, as desired.

In a dusty work atmosphere, that causes throat irritation and dryness, chewing Wrigley's Spearmint Gum helps keep workers' mouths moist and fresh—thereby reducing work interruptions—and "time out" to the drinking fountain.

Workers can stay at their machine, while chewing Wrigley's Spearmint—even when their hands are busy. There is no lost time. And the pleasant chewing helps keep them alert and wide-awake. One Connecticut manufacturer with a dust problem reports group production up about 3% over normal, when workers were given chewing gum. Other plants and factories everywhere, claim stepped-up efficiency when chewing gum is made available to all.

You can get complete information from William H. Howland, 2533 East 73rd Street, Chicago 49, Illinois

AA-70

cago 16, Ill. developed a liquid plastic synthetic resin glue which has long storage life and permanent flexibility for use in print shops and binderies. Known as Pliatab cold padding glue, it contains plasticizing agents which overcome crystallization, hardening and brittleness and which also improve the covering qualities of the glue. One gallon is said to cover 200 sq. ft. of padding area and it may be applied by hand brushing or spray gun. It is available in read and white colors and in quart and gallon jars, 5- and 10-gal. pails and 30- and 55-gal. drums.

BRIGHT FINISH

Known as Iridite bright, a chemical pigment that produces a mirror bright and transparent chromate film on zinc or cadmium plated parts is now available from Rheem Research Products, Inc., 1409 Standard Oil Bldg., Baltimore 2, Md. The coating is claimed to reduce finger marks by forming a corrosion-resistant finish on the surface of the metal. It will not fade or tarnish. No electric current is used in the process. Parts are immersed in the solution for only five seconds, followed by rinsing and drying. A low concentration caustic rinse helps to produce a more brilliant finish. Test panels coated with Iridite bright show no signs of white corrosion after 100 hr. exposure to salt spray tests.

PLASTIC COVERED METAL

Extruded polyvinyl chloride plastic tubing can now be readily applied over a core of metal or other material. Tubing of the desired size is immersed in a dilator solution causing it to swell. The enlarged tubing is removed from the solution and slipped around the core. It then shrinks back to its normal size producing a tight grip. It is anticipated that the plastic tubing may be used in the manufacture of such products as baby carriage handles, refrigeration equipment parts, and for other objects where it is desirable to cover metal rods or tubing with a plastic. It is manufactured by the Canadian General Electric Co., Vancouver, B. C.

HIGH-SOLIDS SYNTHETIC LATEX

According to the Goodyear Tire & Rubber Co., Akron, Ohio, a high-solids synthetic latex has been developed by altering the method of polymerization. Changing the proportion of styrene to butadiene and by using a minimum amount of soap to make the emulsion, the polymerization process was modified to produce this new synthetic latex. It is now possible to produce a wide variety of synthetic latices.

CATALYST

Designed to speed up action of thermosetting resins used in finishing textiles, a new catalyst is now available from the American Cyanamid Co., Bound Brook, N. J. Known as Aerotex Accelerator 187, the catalyst is an acid salt buffered to give maximum stability and optimum pH. Being soluble in water, it is added to the resin bath just before it is ready for use on fabrics. It forms an odorless solution which acts to hasten the polymerization of the resin. The compound has the appearance of fine white crystals and can be stored for long periods of time without damage.

CHEMICAL ENGINEERING NEWS

THIS CHEMICAL EXPERTS STUDY NAZI CHEMICALS

ELEVEN experts from various branches of the American chemical industry recently were assigned to investigate developments in the German chemical field by the Technical Industrial Intelligence Branch, Department of Commerce. Dr. Julius Alsberg, Washington, D. C., is serving as chief of the unit. During the war he was associated with the Chemical Warfare Service and the Foreign Economic Administration. The other members are: Dr. Henry Hess Blau, vice president in charge of production and research, Federal Glass Co., Columbus, Ohio; Dr. William Cecil Gardiner, chemical engineer, Mathieson Alkali Works, Inc., Niagara Falls, N. Y.; Carl Joseph Harbert, Harshaw Chemical Co., Cleveland, Ohio; Howard E. Houser, Dow Chemical Co., Midland, Mich.; Errol Hay Karr, Pennsylvania Salt Mfg. Co., Tacoma, Wash.; Frank P. Lester, John Douglas Mfg. Co., Cincinnati, Ohio; Charles E. Lyon, superintendent, electro-chemical division, Diamond Alkali Co., Painesville, Ohio; Ford H. McBerty, titanium expert, E. I. du Pont de Nemours and Co., Wilmington, Del.; Dr. Jaroslav Jan Peel, chemist, Ford Motor Co.; Dearborn, Mich.; and Dr. Kenneth C. Rule, assistant director, process control department, Westvaco Chlorine Products Co., South Charleston, W. Va.

VACUUM DIFFUSION PROCESS PRODUCES STREPTOMYCIN

A VACUUM diffusion process, developed by National Research Corp., will shortly go into operation at the plant of Merck & Co., in Rahway, N. J., for the production of streptomycin. Streptomycin has been widely publicized as a new antibiotic which attacks certain bacteria untouched by penicillin. Merck has worked with the process from the test tube stage through pilot plant production to full plant scale with entirely new quarters.

In practice the solution of streptomycin is dried at pressures approximately 0.0005 to 0.00005 of atmospheric. The water is driven from the solution and is condensed at low temperatures in the vacuum system in which rotating blades remove the ice as fast as it is formed from the inside of the condenser.

ELECTROCHEMICAL SOCIETY ELECTS MOORE PRESIDENT

WITH headquarters at the Hotel Tutwiler, Birmingham, Ala., the eighty-ninth meeting of The Electrochemical Society, Inc., was held on April 11-13. Technical sessions were held each day at the morning and afternoon gatherings. The Joseph W. Richards Memorial lecturer was Prof. Stewart J. Lloyd, head of the chemistry department, University of Alabama who also was chairman of the local committee in charge of arrangements. At the annual dinner, William R. Veazey, delivered his presidential address on the subject "What did the Presidents Think?" The young authors prize of $100 was given to Austin E. Hardy, 25-year old chemist in the Luminescent Materials Laboratory, Radio Corp. of America, and a prize of $50 was awarded James T. Waber of the Illinois Institute of Technology.

At the annual business meeting reports were submitted by the officers and the board of directors. The tellers of election reported the results of the balloting for officers with the following chosen for the ensuing year: W. C. Moore, U. S. Industrial Chemicals, Inc., president; A. L. Ferguson, University of Illinois, vice president; W. W. Winship, Thermal Syndicate, Ltd., treasurer; and Colin G. Fink, Columbia University, secretary. James A. Lee, *Chemical & Metallurgical Engineering*, is a holdover vice president and at a later meeting of the board, George W. Heise, National Carbon Co., was elected a vice president to replace Mr. Moore who was advanced to the presidency.

JOHN WESLEY HYATT AWARD HAS TWO RECIPIENTS

COINCIDING with the holding of the First National Plastics Exposition which was held in Grand Central Palace, New York, April 22-27, the Society of the Plastics Industry held its annual meeting and two-day conference at the Hotel Commodore on April 22-24. One of the features of the conference was an address by W. S. Landes, president of the Plastics Materials Manufacturers Association and vice president of the Celanese Corp. of America, who discussed the current and future availability of basic plastics raw materials.

At the annual banquet, presentation of the John Wesley Hyatt Award was made to Virgil E. Meharg, superintendent of development, Bakelite Corp., Bound Brook, N. J., and Paul D. Zotta, consulting electronic engineer of Newton, Mass. This award, sponsored by Hercules Powder Co., has been presented annually since 1942 for outstanding achievement in the plastics industry during the preceding calendar year. The award consists of a gold medal and one thousand dollars which in this case was equally divided.

The medalists were selected for their individual work in developing the use of electronic heating of thermosetting plastic materials. Research on electronic or high frequency heating was conducted separately and simultaneously by the two men. Their efforts resulted in speeding up the curing time of molded and laminated plastics and contributed much to the winning of the war.

SUN OIL BREAKS GROUND FOR CARBON 13 PLANT

GROUND was broken last month at Sun Oil Co.'s refinery at Marcus Hook, Pa., for a 500-gram carbon 13 plant. Carbon 13, differing from ordinary carbon in that it contains an extra neutron in the nucleus of the atom, has been found to have great value in probing the secrets of cell growth. Dr. J. Bennett Hill, manager of the re-

Dr. Edward R. Weidlein, director of Mellon Institute of Industrial Research, presents John Wesley Hyatt Awards to Virgil E. Meharg and Paul D. Zotta

search and development division of Sun Oil Co., revealed that much more complicated and involved equipment is needed for the production of carbon 13 than for the manufacture of ordinary chemicals. Dr. Allen F. Reid, who developed the special catalyst for the chemical isotope exchange process to be used in the plant, was among those participating in the ground-breaking ceremonies. The plant will produce about 12 lb. of the rare C-13 a year compared with a current annual world production of about one-half oz.

APPARATUS FOR DETERMINING HEAT DISTORTION

An improved testing apparatus for determining heat distortion properties of plastics is described in a report released by the Office of the Publication Board, Department of Commerce. Research on the apparatus was done during the war for the National Defense Research Committee by the Laboratory of Insulation Research at the Massachusetts Institute of Technology. The report, prepared by Paul F. Ast, is obtainable on order from OPB (PB 4664; photostat, $1; microfilm, 50c.; 15 pages).

The perfected apparatus can be used to

CONVENTION CALENDAR

The Electrochemical Society, Inc., Pittsburgh Section, symposium on surface reactions, Mellon Institute of Industrial Research, Pittsburgh, Pa., June 7.

Paint and Varnish Production Clubs, joint meeting of Toronto, Cleveland, and Western New York Sections, General Brock Hotel, Niagara Falls, Ont., Canada, June 8.

Metal Powder Association, spring meeting, Waldorf-Astoria Hotel, New York, N. Y., June 13.

Society for the Promotion of Engineering Education, 53rd annual meeting, Jefferson Hotel, St. Louis, Mo., June 20-23.

American Society for Testing Materials, annual meeting, Hotel Statler, Buffalo, N. Y., June 24-28.

American Institute of Chemical Engineers, regional meeting, Palace Hotel, San Francisco, Calif., August 25-28.

American Chemical Society, 110th meeting, Chicago, Ill., September 9-13.

Fourth National Chemical Exposition, Chicago, Ill., September 10-14.

Instrument Society of America, first national conference and exhibit, William Penn Hotel, Pittsburgh, Pa., September 16-20.

The Electrochemical Society, Inc., fall meeting, Hotel Royal York, Toronto, Canada, October 16-19.

Federation of Paint and Varnish Production Clubs, annual convention and paint industries show, Hotel Claridge, Atlantic City, N. J., November 4-6.

National Paint, Varnish & Lacquer Association, annual convention, Atlantic City, N. J., November 6-8.

Cellosolve

TRADE-MARK

SOLVENTS

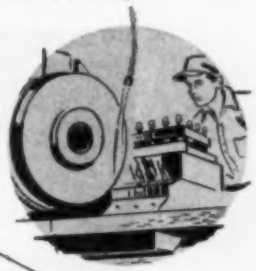
for

LACQUERS

Lacquers formulated with the mild-odored "Cellosolve" solvents have exceptional gloss and film toughness, and do not orange-peel.

SOLUBLE OILS

Because "Cellosolve" compounds are good mutual solvents they are used in dry-cleaning soaps and in soluble oils for textile processing and metal-cutting.



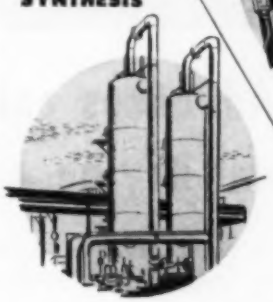
ADHESIVES

Because Methyl "Cellosolve" flows evenly and does not adhere to the machine, it is widely used in the heat-sealing of moisture-proof cellophane.

LEATHER FINISHING

Used with water pigments and dye solutions, "Cellosolve" provides increased penetration, better flow, and an even finish.

CHEMICAL SYNTHESIS



Esters of the "Cellosolve" compounds are finding extensive application as plasticizers for synthetic resins and elastomers.

TEXTILE DYEING

"Cellosolve" solvents increase the solubility of dyes, giving brighter shades.

"Cellosolve" Solvents include: Methyl "Cellosolve," "Cellosolve," Butyl "Cellosolve," Ethylbutyl "Cellosolve," Phenyl "Cellosolve," Benzyl "Cellosolve," Methyl "Cellosolve" Acetate, "Cellosolve" Acetate.

Write for prices and further information on these versatile solvents.

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York 17, N. Y.

The word "Cellosolve" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

determine the limiting heat distortion temperature of plastics by the method specified by the American Society for Testing Materials. In addition, the apparatus embodies certain refinements in design which permit continuous recording of the distortion as function of time and temperature.

The report contains detailed descriptions of the three interdependent units of the instrument: the air test chamber and associated temperature control facilities; the load plunger and mechanical deflection-follower system; and the electronic deflection indicator and deflection-follower control circuit. Five diagrams of the apparatus are also included.

Orders for the report should be addressed to the Office of the Publication Board, Department of Commerce, Washington 25, D. C.

AMERICAN INSTITUTE OF CHEMISTS MEETS

THE twenty-third annual business meeting of the American Institute of Chemists was held at the Hotel Biltmore, New York on May 17. A Symposium on the subject, "The Professional Status of the Chemist" was held.

Robert P. Russell

At the annual banquet, the 1946 gold medal of the institute was awarded to Robert P. Russell, president, Standard Oil Development Co. Dr. Gustav Egloff made the presentation.

GRADUATE FELLOWSHIPS BY STANDARD OF INDIANA

ESTABLISHMENT of 22 graduate fellowships at 17 educational institutions by Standard Oil Co. of Indiana was announced on April 25 by Dr. Robert E. Wilson, chairman of the board, who said the purpose of the program is "to provide 'seed corn' for future research."

Fellowships in chemistry have been established at Northwestern, Illinois, Chicago, Wayne, Ohio State, Wisconsin, Iowa State, and Johns Hopkins; in chemical engineering at Massachusetts Institute of Technology, Minnesota, Illinois, Cornell, Carnegie Tech, and Princeton; in engineering at Michigan, Minnesota, Iowa, Illinois, Purdue, and Illinois Institute of Technology; in civil engineering at Purdue; and in marketing and management at Northwestern.

The fellowships will be awarded to stu-

Valves for Refrigerant Gases

Question: **Why is a diaphragm valve best suited for the control of Freon and other refrigerant gases?**

Answer: **The diaphragm seals against leakage of gas under pressure or in-leakage of air under high vacuum. Diaphragm must be impervious to destructive action of the gas.**

The above cross-sectional view of a Grinnell-Saunders Diaphragm Valve shows how the molded diaphragm of special rubber compound, unaffected by refrigerant gases, prevents the loss of gas under pressure or the in-leakage of air under high vacuum conditions.

WHENEVER PIPING IS INVOLVED

No single type of piping material is suitable for the wide variety of operating conditions encountered in modern process industries. The Grinnell-Saunders Diaphragm Valve typifies the extent to which this company goes to solve the piping requirements of hard-to-handle liquids and gases.

The development of such piping specialties calls for wide piping experience, continuous laboratory research and skilled field engineering – the kind of a background that Grinnell brings to the job from 95 years of piping experience. As specialists in piping, Grinnell can supply everything from a tiny tube fitting to a complete power or process piping installation.

GRINNELL COMPANY, INC. Executive Offices, Providence 1, R. I. Branch warehouses in principal cities. Manufacturing Plants: Providence, R. I.; Cranston, R. I.; Atlanta, Ga.; Warren, Ohio; Columbia, Pa.

GRINNELL

FOUNDED 1850

WHENEVER PIPING IS INVOLVED

dents working for master's or doctor's degrees. They will vary somewhat in amount, depending on the tuition and other fees at the various institutions, but the average for each fellowship will be approximately $1,500 a year.

NEW AWARD FOR EDUCATORS OF ENGINEERING STUDENTS

This year, for the first time, a new award of $1,000 will be given to the college or university teacher adjudged to have contributed most to the successful teaching of engineering students, it has been announced by The Society for the Promotion of Engineering Education. The prize, to be conferred annually, will be known as the George Westinghouse Award in Engineering Education. Established to commemorate the 100th anniversary of the birth of the famed inventor, the award has been made possible by the Westinghouse Educational Foundation.

In announcing the plan, Dr. Harry S. Rogers, president of the Society for the Promotion of Engineering Education and president of the Polytechnic Institute of Brooklyn, made clear that while there are no age limitations in making the award, "consideration will be given especially to the younger men who show by their past record evidence of continuing activity as superior teachers."

ASTM SCHEDULES NUMEROUS TECHNICAL SESSIONS

In addition to the 23 formal technical sessions which are part of the technical program for the forty-ninth annual meeting of the American Society for Testing Materials, there will be more than 200 meetings of the society's technical committees. At the seventh exhibit of testing apparatus and related equipment, many of the country's leading manufacturers and distributors of scientific instruments will feature a large number of wartime and postwar developments. The meeting will be held in the Hotel Statler, Buffalo, N. Y., June 24-28.

STANDARD OIL OF OHIO HAS PURCHASED RESEARCH SITE

An 84-acre tract has been acquired in Cleveland by the Standard Oil Co. of Ohio where the company plans to construct a laboratory wherein its research activities will be consolidated. Cost of the project is expected to be $1,500,000 with construction to start when building materials become available. Present plans call for a building of modernistic design which will set well back from the street to give the atmosphere of a college campus. Company research is now carried on in conjunction with Western Reserve University.

BAYTOWN ORDNANCE WORKS TOLUENE PLANT SALE

All usable facilities of the Baytown Ordnance Works' toluene plant at Baytown, Tex., have been purchased by the Humble Oil and Refining Co. The sale is subject to priority rights of federal government agencies. During the war the plant produced only toluene. It annually produced twice

Specific Protection

. . . against YOUR specific gaseous hazards . . .

NOTE: For protection against carbon monoxide and gases containing it, and for various combinations of toxic gases, use the M. S. A. ALL-SERVICE GAS MASK.

M·S·A *Industrial*

GAS MASKS

The gas or group of gases creating potential respiratory hazards in your plant operations can be countered effectively with M.S.A. *Industrial* Gas Masks. Safety for the wearer is assured by the *right* canister for the specific hazard—comfort by correct design—utility by finer construction. Read the complete details in Bulletin ED-7!

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TORONTO MONTREAL VANCOUVER CALGARY NEW GLASGOW, N. S

the prewar consumption of toluene. Humble Oil & Refining Co. will use the plant for the production of petroleum products, chiefly gasoline components. Although the company expects to continue to produce some toluene from petroleum, the national capacity for toluene production from coal-tar is estimated to be adequate for normal peacetime needs.

Actual cost of the entire plant, including catalysts, chemicals, spare parts and operating supplies on hand as of August 1945, amounted to $14,185,866. The cost of facilities not being purchased by the company is $608,056.

SULPHURIC ACID PRODUCTION INCREASED AT TULSA

THE Ozark Chemical Co., wartime operator of the Ozark Defense Corp. plant at Tulsa, Okla., has extended its present five year lease of the plant's 200-ton per day sulphuric acid unit to include the plant's remaining sulphuric acid unit which has a capacity of 120 tons per day. As a result of increased demands for sulphuric acid, the company plans to operate the entire acid facilities of the plant. The lease agreement provides for a minimum annual rental of $82,500, with a maximum rental of about 75c. per ton (5.1 percent of the average selling price) of sulphuric acid produced. The present fair value of the plant is estimated at $832,000.

PATENTS ON STAINLESS STEEL TUBES UNDER LICENSE

FOURTEEN patents on the manufacture of stainless steel tubes which were seized from enemy nationals are available for licensing to American citizens according to an announcement made by Alien Property Custodian James E. Markham. He said several of these patents disclosed new designs and devices which appear to be practical for use in this country. The inventions are the result of work of enemy technicians in the Dusseldorf area, the heart of the German steel industry.

LAKE CHARLES PLANT LEASED BY SOUTHERN ALKALI CORP.

BUILT during the war for the Defense Plant Corp. for the production of magnesium, a major portion of the plant at Lake Charles, La., has been leased by the Southern Alkali Corp. which is jointly owned by Pittsburgh Plate Glass Co. and American Cyanamid Co. An extensive remodeling program will begin at once and is expected to take a year at the end of which time a long-term lease on the property will commence and the manufacture of caustic soda and chlorine will be initiated.

DU PONT PLANS NEW SULPHURIC PLANT

PLANS have been approved by E. I. du Pont de Nemours & Co. for the eventual construction of a sulphuric acid plant on the James River between Bellwood Road and Kingsland Creek, nine miles southwest of Richmond, Va. The plant, which will be operated by the Grasselli Chemicals department will cost approximately $1,500,000. It

ORONITE CHEMICALS

REG. U. S. PAT. OFF.

THE NAME TO WATCH IN CHEMICALS

REPRESENTATIVE APPLICATIONS	
This End-Product	...Gains These Properties From Oronite Cresylics
Surface Coatings	Increased drying-oil solubility; greater flexibility (when used with phenol and para-substituted phenol)
Flotation Agents	Frothing; high metal recovery
Disinfectants	High phenol coefficient
Detergents (metal)	Penetration; good solvent action; translucence; slow evaporation

CRESYLIC ACIDS...

KEYED TO MANY USES

Oronite Cresylic Acids, now in growing commercial demand, are produced in several grades for flexibility and precise adaptation in a wide field of industrial uses. Further information will be sent without obligation if you will write, on your business letterhead, telling us the applications you have in mind.

TYPICAL TESTS (Grades of Cresylics here shown are offered subject to availability)

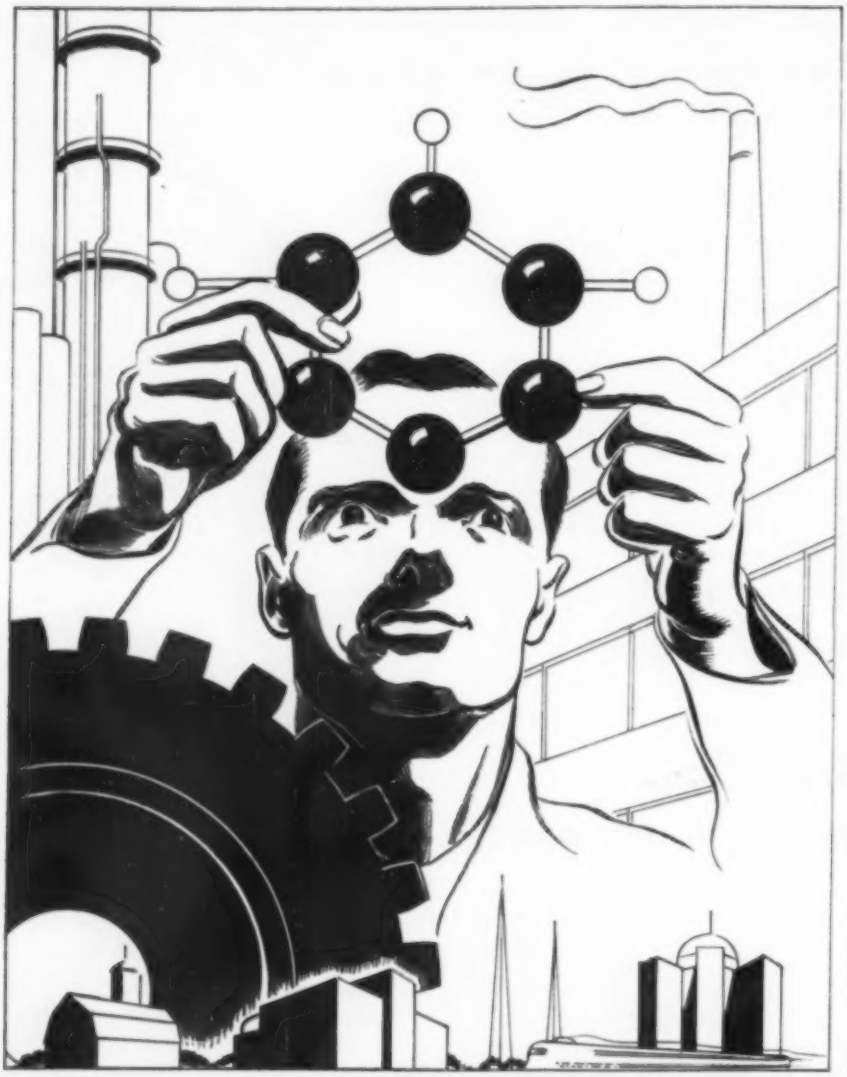
		"D"	"E"	"F"	"FF"	"G"	"H"
Specific Gravity at 60°F.	(ASTM-D287)	1.041	1.029	1.018	1.016	1.009	1.016
Distillation, °C.: 5% Recovered	(ASTM-D447)	188	200	212	213	224	236
50% Recovered		192	207	216	219	231	249
95% Recovered		204	220	227	238	249	262
Neutral Oil, % by volume		0.9	1.0	0.5	0.6	1.0	1.0
Water by Distillation, %	(ASTM-D95)	0.8	0.4	0.2	0.2	0.4	0.6
Mineral Tar Acid Content, %		98.3	98.6	99.3	99.2	98.6	98.4
Sulfur Content, % (Inc. in Mineral Tar Acids)		1.1	0.75	0.50	0.45	0.40	0.50
Flash, °F.	(Cleve.)	200	200	200	210	210	235
Refractive Index at 20°C.		1.5431	1.5406	1.5382	1.5364	1.5329	1.5229
Phenol Coefficient	(F.D.A.)	4-5	6-8	9-11	12-14	16-18	18-20

1179

ORONITE CHEMICAL COMPANY

Russ Building, San Francisco 4, California
White-Henry-Stewart Bldg., Seattle 1, Wash.

30 Rockefeller Plaza, New York 20, N.Y.
Standard Oil Bldg., Los Angeles 15, Calif.



CHICAGO COLISEUM

NATIONAL CHEMICAL EXPOSITION

SEPT. 10, 11, 12, 13, 14

☆ 1946 ☆

will be located on a 425-acre site recently purchased by the company and will produce sulphuric acid for local consumers who previously relied on supplies shipped into the area.

Sulphur for the James River Works, as it will be called, will arrive in ocean-going vessels at the Richmond deepwater terminal. The plant will be connected to the Seaboard Airline Railway by a 2,000-ft. spur. Construction will start when proper federal approval is obtained and materials are available.

PITTSBURGH PLATE GLASS BUYS PLANT AT NATRIUM

EXERCISING its option to purchase, the Columbia Chemical Division of Pittsburgh Plate Glass Co. has acquired the chlorine and caustic soda plant at Natrium, W. Va. The plant, which is one of the largest chlorine producers ever built as a single unit east of the Mississippi River, was built and operated by the Columbia Chemical Division for the Defense Plant Corporation and first went into production in July 1943. It consists of six principal buildings, all functional in design and construction. They include a chlorine manufacturing building, machine shop, power house, caustic manufacturing building, administration building, and a combination employment office and gate house.

GRANTS TO AID RESEARCH IN AGRICULTURAL CHEMISTRY

GRANTS of up to $10,000 a year for five years to aid research in agricultural chemistry are being offered to universities and other non-profit research institutions throughout the country by the Herman Frasch Foundation for Chemical Research.

Designed to stimulate research which will be of practical benefit to the agricultural development of the United States, the grants are made every five years from a trust fund set up under the will of Elizabeth Blee Frasch in memory of her husband, Herman Frasch, who invented the process of mining sulphur by steam and who was for many years president of the Union Sulphur Co.

NEW PLANT PLANNED FOR X-RAY SCREENS

A NEW plant for the manufacture of X-ray fluoroscopic and intensifying screens will be constructed in North Towanda, Pa., by E. I. du Pont de Nemours & Co. It will be operated by the Patterson screen division of the photo products department. The new plant will be adjacent to present phosphors operations and will replace the plant in the business section of Towanda. Construction will begin when building materials are available.

NATIONAL INSTRUMENTATION CONFERENCE AND EXHIBIT

PLANS have been completed for the first National Instrumentation Conference and Exhibit to be held in the William Penn Hotel, Pittsburgh, September 16-20. The conference and exhibit, sponsored by The Instrument Society of America, was originally planned for the corresponding week

in September 1945 but was changed to avoid interfering with the heavy transportation demands at that time.

The Instrument Conference held in conjunction with the Exhibit will include daily technical sessions. Several other societies are planning instrumentation programs in Pittsburgh at that time. An unusual feature of the technical program will be a series of educational courses (short courses) which will be directed by Dr. B. R. Teare, professor of electrical engineering at Carnegie Institute of Technology. Dr. Teare is chairman of the educational committee of The Instrument Society of America.

CPA APPROVES COMPLETION OF NEW HERCULES PLANT

THE Civilian Production Administration has approved the completion of the chemical plant being constructed by Hercules Powder Co. at Burlington, N. J. The CPA stop construction order to industry will not apply to the plant because the company had already ordered equipment for the plant.

READERS' VIEWS and COMMENTS

CHLORINE TRIFLUORIDE

To the Editor of Chem. & Met.:

Sir:—With reference to your item on a new liquid incendiary agent (*Chem. & Met.*, Dec. 1945, p. 184), please allow me to give you some notes which I think will be of interest. I was a fluorine chemist for many years, prior to my having to leave Germany as a refugee in 1936.

The ClF_3 was first obtained in 1928 by O. Ruff and myself[1] as a byproduct of another Cl-F compound, the ClF, and then identified in 1930 by O. Ruff and H. Krug.[2] Dr. Kwasnik was another member of the staff of Professor Ruff at the Technical High School in Breslau, who in these years happened to discover a number of very interesting, new gaseous fluorine compounds. You can find nearly all the facts that you mention in your note, in numerous publications of the *Zeitschrift fur anorganische und allgemeine Chemie*, especially in the years of 1928 to 1933.

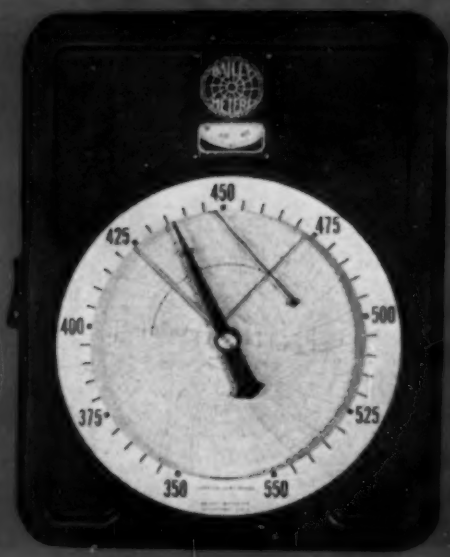
I don't believe that the ClF_3 had its importance only as a new incendiary agent. There are cheaper ones that will fulfill the same purpose. But ClF_3 is the most violent fluorinating agent for all kinds of metals that cannot be fluorinated otherwise. For example, the UF_6 that probably has been used for the separation of the uranium isotopes, was first obtained[3] from metallic uranium by fluorination only in presence of chlorine, that is, with ClF_3 as intermediate agent. Pure ClF_3 gases will probably burn uranium and its compounds immediately. I therefore think the Germans used ClF_3 for their investigations on the atomic bomb.

DR. E. ASCHER
Mauricio Hochschild y Cia., Ltda.
Antofagasta, Chile

REFERENCES

1. Ruff, O., and Ascher, E., *ibid.*, 176, 258, 1928.
2. Ruff, O., and Krug, H., *ibid.*, 190, 270, 1930.
3. Ruff, O., and Heinzelmann, A., *Z. anorg. Chem.*, 72, 63, 1911.

3 WAYS to CONTROL TEMPERATURE



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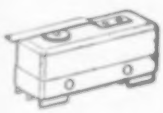

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Dr. Eric K. Rideal, international president of SCI and Fullerian professor in the Royal Institution of London with S. D. Kirkpatrick (left) vice chairman and Francis J. Curtis (right) chairman of the American Section of the Society of Chemical Industry

One World Through Science

C. J. KRISTER
American Correspondent,
Society of Chemical Industry, P. O. Box 47, Wilmington, Del.

Editor's Note: Through the courtesy of T. W. Jones, editor and manager of publications of the Society of Chemical Industry of Great Britain, we are permitted to reprint Mr. Krister's account of a significant Anglo-American meeting held in New York April 4. This encouraging evidence of mutuality of interest in our common heritages should do much to promote better understanding and more friendly relations with our British brothers.

THROUGH the continuous and vigorous efforts of the chosen statesmen of the world, the United Nations has progressed a rough path from San Francisco to New York. One crisis after another has been survived and the cause of peace has been advanced by prodding and deliberative forces. Almost unrecognized during this period was the potentially large contribution toward world cooperation being made by chemists from various parts of the world, such as was evidenced by the Anglo-American dinner and meeting in New York on April 4 and sponsored by the American Section of the Society of Chemical Industry and the New York Section of the American Chemical Society. Gathered together for this signal event were chemists of many nations, all deeply concerned with the reestablishment of international co-operation and understanding, which is the necessary but firm foundation of science and the progress of humanity toward one world through science.

That concern with establishing better international relations through scientists was stressed by Prof. Eric K. Rideal, international president of the Society of Chemical Industry, who was the principal guest and speaker on this occasion. Emphasizing the successful cooperation of British and American scientists in World War II, Dr. Rideal declared that the postwar world of peace requires a community of interests and that scientists having the ties of a common vocation can do much to promote greater international understanding. He extended the hope that the international aspects of the Society of Chemical Industry will develop and expand, and declared that the way may be most clearly and readily shown by those starting with the important advantages of a common language, a common law and a common philosophy.

Dr. Rideal, discussing "Chemical Research—Academic and Technological," also expressed the belief that scientists in the future should play a greater role in their governments. Describing the Society's responsibilities toward research workers in government service, he said, "It is hoped that in the near future a larger number of government executives may be drawn from these ranks. The impact of science on politics and government is now so great in this scientific age that the scientific method of approach to these problems must be part of the government itself and not a mere appendage to be consulted only when desired."

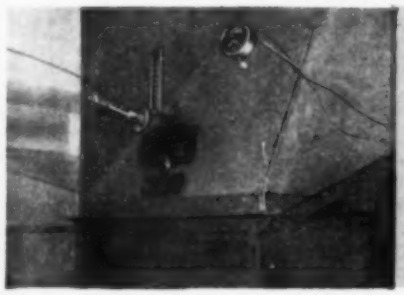
Deploring the enforced secrecy under which government scientists, and particularly those associated with military services, must operate, Dr. Rideal said that although he did not believe all information obtained by the services should be made available at once to the scientific world, nevertheless he regarded the present policy as much too strict. "Instead of everything inside the service departments being automatically on the secret list and only released after much trial and tribulation," he declared, "research should automatically be free but put on the secret list only where desirable."

"Fundamental research is and should remain the aim of the university laboratories," Dr. Rideal continued, "while technological research may be said to have for its pur-

J. W. H. Randall, honorary treasurer of the American Section of the Society of Chemical Industry, Col. Bradley Dewey, president of ACS, Mrs. Dewey, and S. D. Kirkpatrick

Dr. Rideal, Lady Heilbron, Mr. Curtis, Mrs. Wallace P. Cohoe and Sir Ian Heilbron, 1946 Priestley Medallist of the American Chemical Society

HOW SARCO SAVES
... IN THE CHEMICAL INDUSTRY

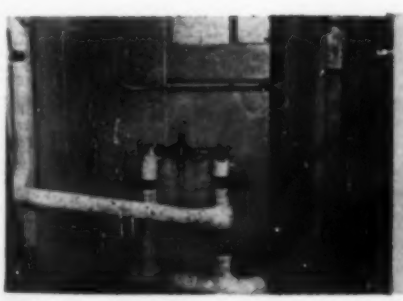


Matches

A Sarco KR-14MD temperature control protects temperature in the rooms where matches are dipped. "It's the cheapest insurance we ever bought" says the owner. Bulletin No. 600.

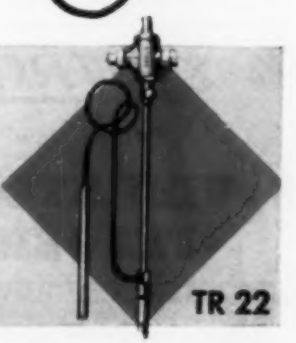
Stills

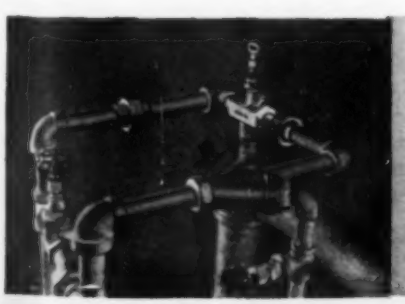
A large pharmaceutical company bought six Sarco Electric Controls for steam jacketed stills; now has 142 in use and the plant "goes like clock-work." This is the inexpensive control that is used also for many other heating and cooling operations. Bulletin No. 1025.



Drying Ovens

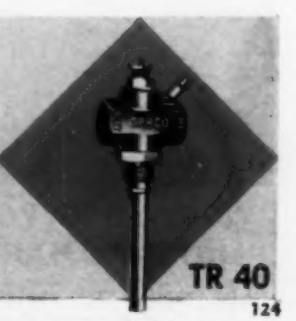
Varnish ovens and dipping tanks must be at the exact temperature. A few Sarco temperature controls insured and increased production with few rejects. Bulletin No. 600.





Condensers

When the little Sarco TR-40 cooling control was installed on this 3-story-high condenser, less than a fourth of the cooling water was required. Output was increased, uniformity of product insured. Bulletin No. 700.



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pose the development of new effects resulting from scientific causes. There is a natural interrelation between the two and each is stimulated by the other."

Present at the head table for the evening, seated in the conventional manner, were J. W. H. Randall, honorary treasurer of the American Section; L. W. Bass, past president of the American Institute of Chemical Engineers; Sidney D. Kirkpatrick, vice-chariman of the American Section; Col. Bradley Dewey, president of the American Chemical Society; Prof. Marston T. Bogert, past president of the Society of Chemical Industry and president of the International Union of Pure and Applied Chemistry; Dr. W. H. Stephens, acting director of the British Scientific Mission; Dr. E. K. Rideal, honored guest and speaker; Francis J. Curtis, chairman of the American Section; Sir Ian M. Heilbron, distinguished guest and Priestley medallist; W. G. R. Howell, His Majesty's Consul representing Lord Halifax; Dr. Wallace P. Cohoe, past president of the Society of Chemical Industry and Messel medallist for 1946; Dr. T. W. Smith, chairman of the Canadian Section of the Society of Chemical Industry; Alden H. Emery, newly elected Secretary of the American Chemical Society; and C. S. Kimball, honorary secretary of the American Section, Society of Chemical Industry.

The attendance was marked by a number of distinguished British, American and other scientists who were present to honor president Rideal. Among these were Dr. Charles Penrose, Senior vice president for North America of the Newcomen Society of England; Dr. Rudolf Mebus, prof. of industrial chemistry, University of Santiago, Chile; Prof. Harold Raistrick, honorary scientific adviser on penicillin production to the Ministry of Supply of Great Britain; Dr. R. S. Jayne, vice president and director of research, Shawinigan Chemicals, Ltd. and past chairman of the Canadian Section of the Society of Chemical Industry; Dr. Cornelia T. Snell, chairman, New York Section of the American Chemical Society; Dr. Richard Seligman, Aluminum Plant & Vessels (London); E. F. McTaggart, consulting chemical engineer of London; Dr. R. G. W. Norrish, professor of physical chemistry at Cambridge University; Prof. Hugh S. Taylor, dean of chemistry, Princeton University and J. D. Lorimer of the Canadian Section of the Society of Chemical Industry.

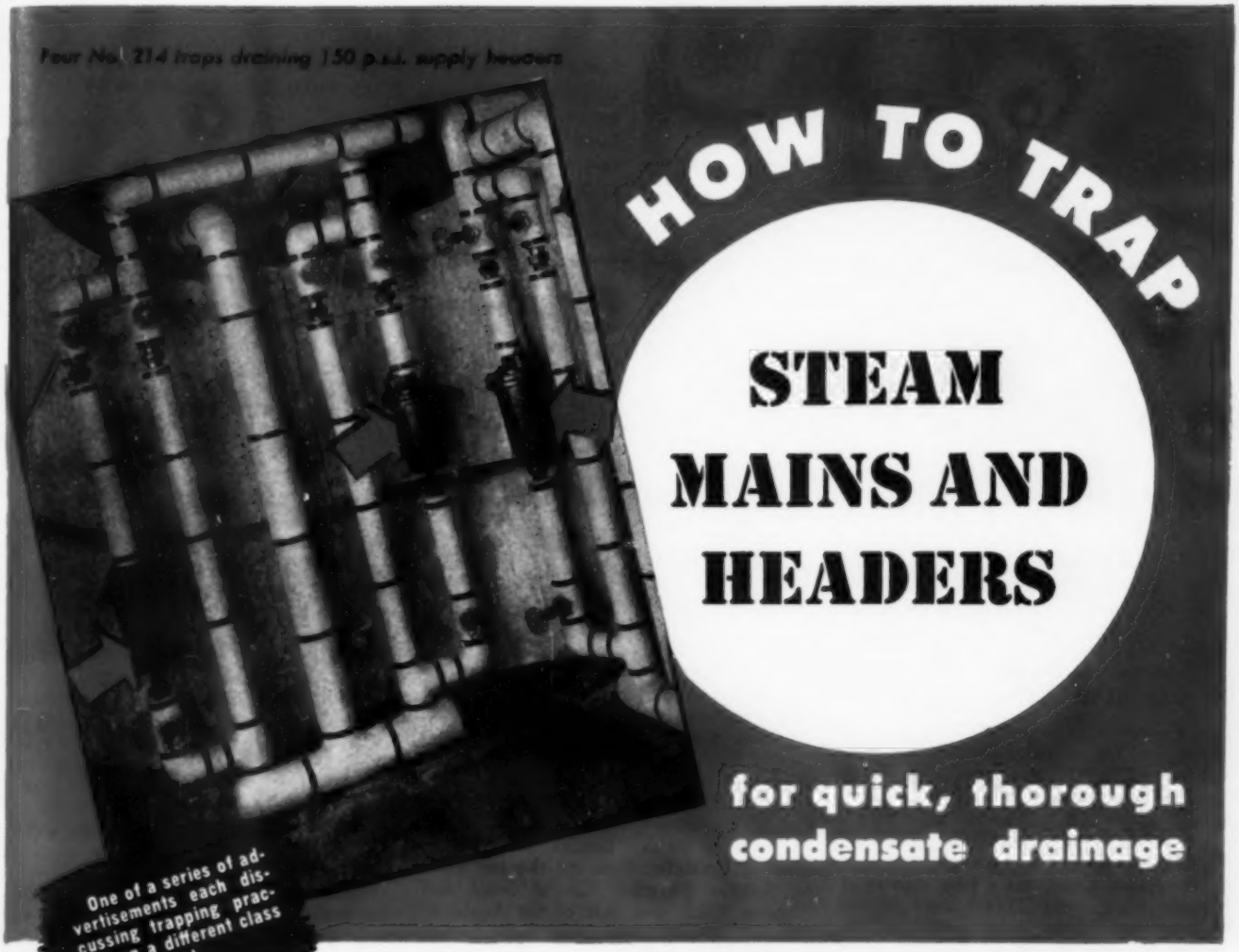
During the dinner the distinguished guests at the head table and the visitors at the dinner were introduced by chairman Francis J. Curtis. The audience was informed that J. W. H. Randall was retiring from his position as honorary treasurer of the American Section which he had held since 1931. It was also disclosed that C. S. Kimball was retiring as secretary of the Section, a position which he had held since 1937. Dr. Kimball has been nominated for the vice presidency of the parent society.

Chairman Curtis read a resolution of appreciation to the Council in London for the awarding of the Messel Medal to Wallace P. Cohoe, who, with Mrs. Cohoe plan to be in England in July to receive this international recognition.

Next followed the introduction of Sir Ian M. Heilbron, distinguished professor of organic chemistry in the Imperial College of Science and Technology, who had just arrived in the United States to receive the Priestley Medal of the American Chemical Society at its Atlantic City meeting. Sir Ian transmitted the message that not only British chemists but chemists of all the European nations looked toward resumption of the International Union of Pure and Applied Chemistry at an early date, and paid a well deserved compliment to its president, Col. Marston T. Bogert of Columbia University. He emphasized the value of common interests and expressed the hope that the tremendously important work that the Union had begun in the years prior to the war would soon be resumed so that continuing advances could be accomplished. Following president Rideal's address, a rousing vote of thanks were extended to the distinguished guests and speakers of the evening by the audience. This meeting was marked by an expression of good will which should do much toward insuring a cooperative attitude among at least the chemical segment of the Anglo-American nations.

Dr. Richard Seligman, Aluminum Plant and Vessels, of London and Dr. R. G. W. Norrish, professor of physical chemistry, Cambridge University

Prof. Harold Raistrick, honorary scientific advisor on penicillin production in the British Ministry of Supply confers with Dr. Rudolph E. Gruber of Merck & Co., and Dr. Wallace P. Cohoe, past president of the Society of Chemical Industry



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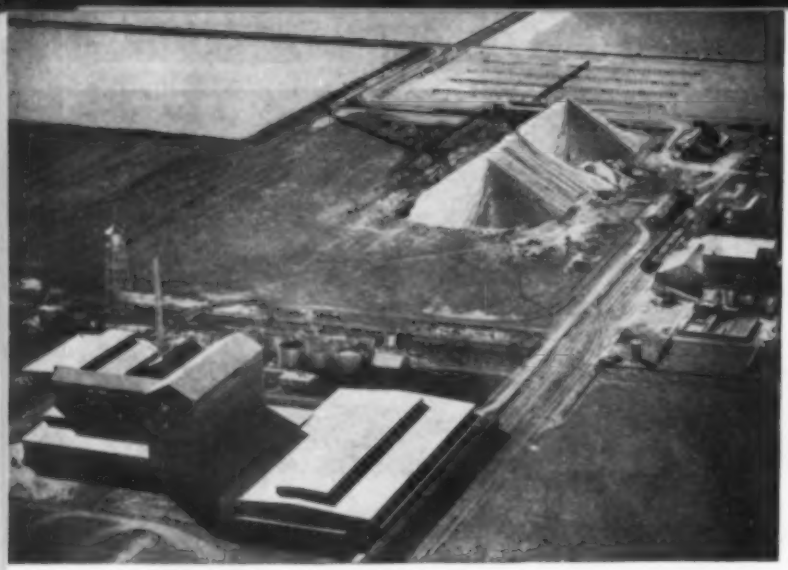

Some 70 percent of the total salt output on the Pacific Coast comes from this refinery of Leslie Salt Co. of Newark, Calif. About a third of the production goes to manufacturers of chlorine and caustic soda. Bitterns left after solar evaporation are piped to a near-by plant for use in production of magnesia

PACIFIC PROCESS INDUSTRIES

TRENDS • EVENTS • DEVELOPMENTS

JOHN R CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

BAY AREA SALT GOES TO CHLORINE PLANTS

Approximately one-third of the 500,000 tons of salt produced annually by Leslie Salt Co. on San Francisco Bay goes to the chemical industry as crude salt for the manufacture of chlorine and caustic soda, according to the company. This firm, accounting for about 70 percent of the total salt output on the Pacific Coast, has a large refinery at Newark, Calif., and 25,000 acres of salt beds between Mount Eden and Palo Alto on the East Bay. It also has a new development on the west shore adjacent to Redwood City which, expected to be in full production by about 1949, will have a capacity of some 200,000 additional tons. Leslie now refines over 100,000 tons of salt annually, mostly for human consumption. Bitterns left after crystallization of the salt by solar evaporation are piped to the nearby plant of Westvaco Chlorine Products Co. for use in producing magnesia.

Total production of salt in California during 1945 fell to about 735,000 tons from the 769,900 net tons reported for 1944, the largest annual yield on record and about 5 percent of total United States output for the year. The figure for 1943 was 631,800 tons. Most of the state's production of salt is from solar evaporation of sea water from plants on the shores of San Francisco, Monterey and San Diego bays. Additional amounts are derived from lakes and lake beds in the desert region and from rock salt deposits estimated to contain about 80 million tons.

IDAHO SUPERPHOSPHATE UNIT BOUGHT BY SIMPLOT

Purchase of the government-financed superphosphate plant in Pocatello, Idaho, has been announced by J. R. Simplot Fertilizer Co., which has operated the unit since its erection in 1944. Purchase price is reported to be $400,000. Although originally designed to produce 60,000 tons of superphosphate yearly, recent additions should enable the factory to produce 150,000 tons of commercial fertilizer by June in order to supply Idaho and Utah demands (see *Chem. & Met.*, April 1946, p. 186). The plant, located on 10.4 acres of land, obtains phosphate rock from Caribou County, Idaho.

Of the 170 superphosphate plants in the United States, only 4 are located in the 11 western states. Besides the Simplot plant at Pocatello, these are the two units of Stauffer Chemical Co. at Stege and Vernon, Calif., and that of the Anaconda Copper Mining Co., Anaconda Mont., which also produces a concentrated superphosphate. Western consumption of this fertilizer material has greatly increased within recent years.

MORE GOVERNMENT PLANTS LEASED BY INDUSTRY

Five more western chemical or related plants were leased for long-term periods from the War Assets Corp. during February, the most recent report of that organization shows. A larger number of plants are being operated by industry on an interim basis for short terms. The following table shows the recently announced changes in status of government-owned plants in the West. (For a listing of earlier sales and leases, see *Chem. & Met.*, April 1946, p. 192.)

Recent Leases of Western Industrial Plants by War Assets Corp.

Former Operator	Plant Location	Lessee	Cost of Facilities Leased	Term
Aluminum Co. of America	Spokane, Wash.	Kaiser Cargo, Inc.	$22,270,000	5 yr.
Aluminum Co. of America	Trentwood, Wash.	Kaiser-Fraser Corp.	47,630,200	5 yr.
Basic Magnesium, Inc. (part)	Henderson, Nev.	U. S. Vanadium Corp.	1,360,842	5 yr.
Mohawk Petroleum Corp.	Bakersfield, Calif.	Standard Oil of Calif.	1,519,148	2 yr.
Pacific Rubber & Tire Mfg. Co.	Oakland, Calif.	Pacific Rubber & Tire	1,400,000	5 yr.
Zuni Milling Co.	Los Lunas, N. M.	Zuni Milling Co.	259,608	2 yr.
Utah Oil Refining Co.	Salt Lake City, Utah		15,900,000	30 day*
Western Electrochemical Co.	Los Angeles, Calif.		1,971,521	30 day*
Panhandle Carbon Co.	Eunice, N. M.		2,750,000	15 day*
Air Reduction Sales Co.	Portland, Ore.		192,999	30 day*
Gladding, McBean & Co.	Provo, Utah		599,674	30 day*
Hooker Electrochemical Co.	Tacoma, Wash.		230,000	30 day*

* Days' notice for termination.

PUMP MANUFACTURER'S EXPANSION PROGRAM UNDER WAY

Although delayed for several months by materials and labor shortages, the $1,500,000 expansion program announced last year by Byron Jackson Co., Los Angeles is now getting into full swing. It is now anticipated that the building program will be completed within about six months. Included in the expansion are new buildings in Vernon, Calif., for the firm's pump division and the doubling of manufacturing facilities in Houston, Tex. The Vernon buildings will consist of a machine shop, cleaners and welders department, pattern shop, service building, stockroom and storage and office building.

One of the most interesting parts of the new Vernon facilities will be the pump test laboratory, now under construction. Intended to be one of the most complete and modern laboratories of its kind in the world, these facilities will be used largely for research on new and improved horizontal and vertical centrifugal pumps and submersible electric motor designs and for exact testing of scale models as well as commercial units. The test range covered will vary from 0.5 to 2,500 hp. and motors will be available at all 60 cycle speeds from 10 to 2 pole. Complete modern facilities will be maintained for all electrical, capacity, pressure and speed measurements.

RESEARCH FOUNDATION LOCATES AT STANFORD UNIVERSITY

Present location of the recently-organized non-profit Pacific Research Foundation will be at Stanford University, Palo Alto, Calif., according to current indications. Accepting the responsibility of establishing the Foundation at Palo Alto, the Board of Regents of the University has agreed to cooperate by allocating the use of some of its engineering buildings and equipment. Availability of such facilities will enable organizational and research operations to get under way in the near future, according to Dr. Henry T. Heald, president of Illinois Institute of Technology and the Armour Research Foundation. Dr. Heald, at the invitation of the Foundation, recently completed a special study of the work that has been done by the group and of the best ways and means of getting operations started. At the invitation of Stanford University, Dr. Clyde Williams, director of Battelle Memorial Institute, came to California in May to discuss further the best

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plan of operation for the Pacific Research Foundation. Efforts are now being made to select the director, after which a plan of operation and research staff will be selected.

Only one of its kind on the West Coast, the Pacific Research Foundation was incorporated last year (see *Chem. & Met.*, Dec. 1945, p. 168, for background of organization) for the purpose of providing the highest type of scientific research facilities and personnel to western industry on a non-profit basis. On-the-spot facilities for research and experimental engineering will be made available to both large and small industries in such fields as chemistry, metallurgy, physics, mechanics and hydraulics, electronics, ceramics and bacteriology. Under the direction of its vice president and general manager, Ernest L. Black of Los Angeles, the Foundation has worked in close cooperation with western universities, directors of research laboratories of western industries, and with directors of the five existing non-profit research foundations of the East.

Commenting on the vital need for a first-class research organization to serve Pacific Coast industry, Dr. Heald stated that the Pacific Research Foundation "can expect to undertake projects sponsored by (1) individual companies for the solution of specific company problems, (2) groups of companies acting through associations which have problems of common interest, (3) federal governmental agencies such as the Army and Navy, and (4) state and local governmental agencies interested in work of public interest or a regional character."

ALUMINUM POTLINES OPERATE IN NORTHWEST PLANTS

PLANS have been announced for the immediate resumption of aluminum production by Kaiser Cargo, Inc., at Spokane, Wash., and by the Reynolds Metals Co. at Troutdale, Ore. According to reports, Kaiser plans to operate four potlines initially and eventually all six potlines at Spokane, which was recently leased for a 5-yr. period from War Assets Corp. Under the lease term, the Kaiser company was required to operate only two potlines initially. A sudden demand for aluminum has led the company to proceed on the basis of four potlines at the start of operations.

In its agreement to lease the Troutdale plant, Reynolds Metals Co. specified that it would operate all four potlines continuously during the first two of its 5-yr. contract with War Assets Corp. Reynolds is continuing full operation of its privately-owned reduction plant at Longview, Wash. In addition, Aluminum Co. of America has indicated that it plans to continue full-time operation of its five potlines at Vancouver, Wash., and to operate them at overload capacity.

Resumption of operation of the Troutdale and Spokane reduction plants again places the Pacific Northwest in the lead in this light metals industry, with the three operating companies sharing about equally the aluminum capacity of the region. The only reduction plant in the Northwest that at present shows no prospects of being put back into production soon is that operated in Tacoma by Olin Corp.

NEW PLYWOOD PLANT MAKES BATTERY SEPARATORS

CONTRACT was awarded during April by Cascades Plywood Corp., Portland, Ore., for construction of a $300,000 battery separator plant. Originally scheduled for Salem, the plant will be built at Lebanon, Ore., because of zoning difficulties. The new unit will be located at the firm's present plywood plant at Lebanon, which has an annual capacity of 120,000,000 sq. ft. of ⅜ in. 3-ply board with four dryers and three hot presses.

Future prospects of the storage battery business indicate that there is an urgent need for these new manufacturing facilities, stated M. D. Tucker, president of Cascades Plywood Corp. The plant, which will employ about 150 persons, will be equipped with the newest and most modern machinery available, which should make it one of the most up-to-date plants in the plywood battery separator industry.

BAY AREA SEWAGE PROBLEM UNDER STUDY

DEMAND by the California State Board of Health that the San Francisco Bay area's critical sewage problem be completely corrected this year has led the industrial committee of the California State Chamber of Commerce's Central Coast Council to call for early, unified action. Weller Noble of Pacific Guano Co., Berkeley, chairman of the committee, states that inadequate sewage treatment facilities of the Bay area have been greatly aggravated by the large industrial and population growth of the region. Adequate treatment plants must be built by communities if the area's industrial growth is to continue, he added.

The State Board of Health has revoked, effective January 1, 1947, all permits heretofore issued for disposal of raw and untreated sewage in any California waters. Los Angeles and nine adjacent municipalities were sued for failure to provide proper sewage treatment and are now under court order to have adequate sewage treatment

Aluminum Capacity and Operations in the Northwest

Operator	Plant Location	Capacity, Lb. per Yr.[1]	Prospective Operations, Lb. per Yr.[2]
Aluminum Co. of America	Vancouver, Wash.[3]	172,000,000	172,000,000
Kaiser Cargo, Inc.	Spokane, Wash.[4]	216,000,000	144,000,000
Olin Corp. (down)	Tacoma, Wash.	41,000,000	.....
Reynolds Metals Co.	Longview, Wash.[3]	62,000,000	62,000,000
Reynolds Metals Co.	Troutdale, Ore.[4]	141,000,000	141,000,000
	Total	632,000,000	519,000,000

[1] Figures on capacities vary somewhat. [2] Either now operating or reported soon to be operating at approximately the stated figure (see accompanying news note.) [3] Privately owned. [4] Under 5-yr. lease.

works in operation within a stipulated time. Unless the San Francisco Bay area disposal system is corrected this year, many communities may be subject to similar court action.

EASTERN FIRM BUYS STOCK OF AMERICAN POTASH

PURCHASE of 100,000 class B shares of stock in the American Potash & Chemical Corp., Los Angeles, Calif., has been made by Heyden Chemical Corp. and approved by the Alien Property Custodian and the Secretary of the Interior. The 100,000 shares are part of 478,194 shares seized by the Alien Property Custodian. The remainder of the shares have been widely distributed through resale to the public.

Producer of lithium phosphate, bromine, borax and boron products, soda ash and salt cake, American Potash is also the only producer of potash on the West Coast, supplying substantially all potash used in agriculture in the area. (See also p. 206.) Heyden is primarily a producer of pharmaceuticals and fine chemicals with plants located at Garfield and Perth Amboy, N. J. Among its major products are formaldehyde and derivatives, salicylic acid and derivatives, and penicillin.

NEW SOAP FACTORIES TO GO UP NEAR LOS ANGELES

PERMISSION has recently been granted by the Los Angeles County Board to the Silicon Products Co., Los Angeles, to erect and operate a soap factory southwest of Ontario, Calif. The $30,000 plant will contain 22,000 sq. ft. of floor area and will be located along a trunk line railway right-of-way. It is expected that 40 people will be employed at the new factory.

The cold process of saponification will be used, according to reports, and drying will be done by spraying the melted soap into a tower countercurrent to an upward stream of warm, dry air. This method produces a soap in the form of granules or beads. Glycerin will not be recovered. In addition, another new plant will be erected by the company at Long Beach, Calif., but no date has been set for starting construction.

TUNGSTEN PROCESSING BEGINS AT LAS VEGAS

FULL-SCALE operation of a tungsten processing plant will be under way by midsummer in vacant units of the former BMI plant at Las Vegas, Nev., according to recent information from U. S. Vanadium Corp., a subsidiary of Union Carbide & Carbon Corp., New York. The company has leased for a term of five years facilities which cost the government some $1,360,800. The new unit will obtain tungsten concentrates from the company's mine near Winnemucca as well as from other Nevada producers of scheelite and wolframite. Some 200 tons of scheelite concentrate has already been shipped to the Las Vegas unit, which is expected to use at least 100 full-time employees by July.

Addition of U. S. Vanadium Corp. to the list of firms now leasing BMI facilities brings to five the number of companies

operating at Henderson, which has become the chemical center of Nevada within a few months. Other firms located at BMI include Stauffer Chemical Co., Amecco Chemicals, Inc. (Hardesty Chemical Co.), New York-Ohio Chemical Co., and Western Electrochemical Co. (See *Chem. & Met.*, Jan. 1946, p. 176.)

Major source of tungsten concentrates at present is the Riley mine of U. S. Vanadium Corp. near Winnemucca, which is equipped with a 250-ton concentration plant recently enlarged to handle 500 tons daily. The mill, according to reports, has been changed to a complete flotation unit which steps up concentration of the ore to 15 percent. In addition, the firm has a privately-owned plant at Bishop, Calif., which treats concentrates from the Pine Creek mine with soda ash, eventually recovering a tungsten oxide product. The government-owned Salt Lake City tungsten plant, reportedly still operated by U. S. Vanadium Corp., also uses a soda ash digestion process.

WASATCH CONVERTS CODIMER UNIT TO MOTOR FUEL

At the end of the war, the codimer unit of Wasatch Oil Refining Co. at Woods Cross, Utah, was producing octene for conversion into iso-octane at other locations. With the decline in demand for aviation gasoline, however, the unit was converted to the production of polymer gasoline. It is planned to continue this operation indefinitely. The Woods Cross refinery, which has been rated at 2,200 bbl. crude oil daily, has a cracking capacity of 1,400 bbl. daily.

Constructed in 1943 to produce iso-octene from unsaturated hydrocarbons, particularly butene, from cracking still gases, the Wasatch codimer unit also processed unsaturated gas from the Idaho Refining Co. at Pocatello, Idaho. The actual octene produced was first shipped to various Pacific Coast plants for conversion into iso-octane by alkylation or hydrogenation. Later it was diverted to the Sinclair, Wyo., plant of Sinclair Refining Co. for alkylation and finally to the DPC unit operated by Utah Oil Refining Co. at Salt Lake City. Present production, based on propene and butenes in the Woods Cross cracking still gases, is used in blending of premium grade motor fuel for the firm's regular trade.

CHEMICAL FIRM SUES UNION FOR SULPHURIC STOPPAGE

In a suit filed during early April in the District Federal Court at San Francisco, General Chemical Co. is asking damages of $100,000 each from the International Oil Workers Union (CIO), Local 518 at Richmond, Calif., 50 strike pickets and 6 union leaders. Basis of the suit is a charge by the company that the union went on strike on November 23 against the Richmond sulphuric acid unit, built in 1943 for DPC and recently purchased by the firm (see *Chem. & Met.*, April 1946, p. 174) without first observing the 30-day "cooling off" period provided by the War Labor Disputes Act. The complaint accused the union of failing to file strike notice with the War Labor Board, National Stabilization Board, Secretary of Labor and the NLRB. The strike, still in progress at

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mid-April, together with other stoppages at nearby acid units, has seriously affected sulphuric acid and other dependent chemical operations in northern California.

BORATES AND SODA SET PRODUCTION RECORDS

Outputs of borates and sodium salts in California for 1945 increased over those for the previous year, according to statistics just published by the California Division of Mines, San Francisco. A total of 314,415 net tons of borate material was produced as compared with 276,398 net tons for 1944. Recalculated to a basis of 40 percent anhydrous boric acid, approximately the average ABA content of colemanite after calcining and of crystallized borax obtained from evaporation of lake brines, the 1945 output totaled 257,299 net tons as compared with 234,860 tons for 1944. Material shipped included the sodium borates, kernite (rasorite), kramerite from Kern County; crystallized borax from evaporation of brines at Searles Lake and Owens Lake; and a small amount of colemanite from Death Valley.

Production of sodium salts included soda ash, trona and salt cake. Shipments made during 1945 totaled 311,236 net tons valued at $3,793,571 as compared with 299,574 tons worth $3,647,630 in 1944. The 1945 output had the largest amount and value of any annual production ever reported in the state. Of the total shipments for the past year, 193,785 tons represented soda ash and 117,451 tons salt cake. The attached table shows California producers of borates and sodium salts during 1945.

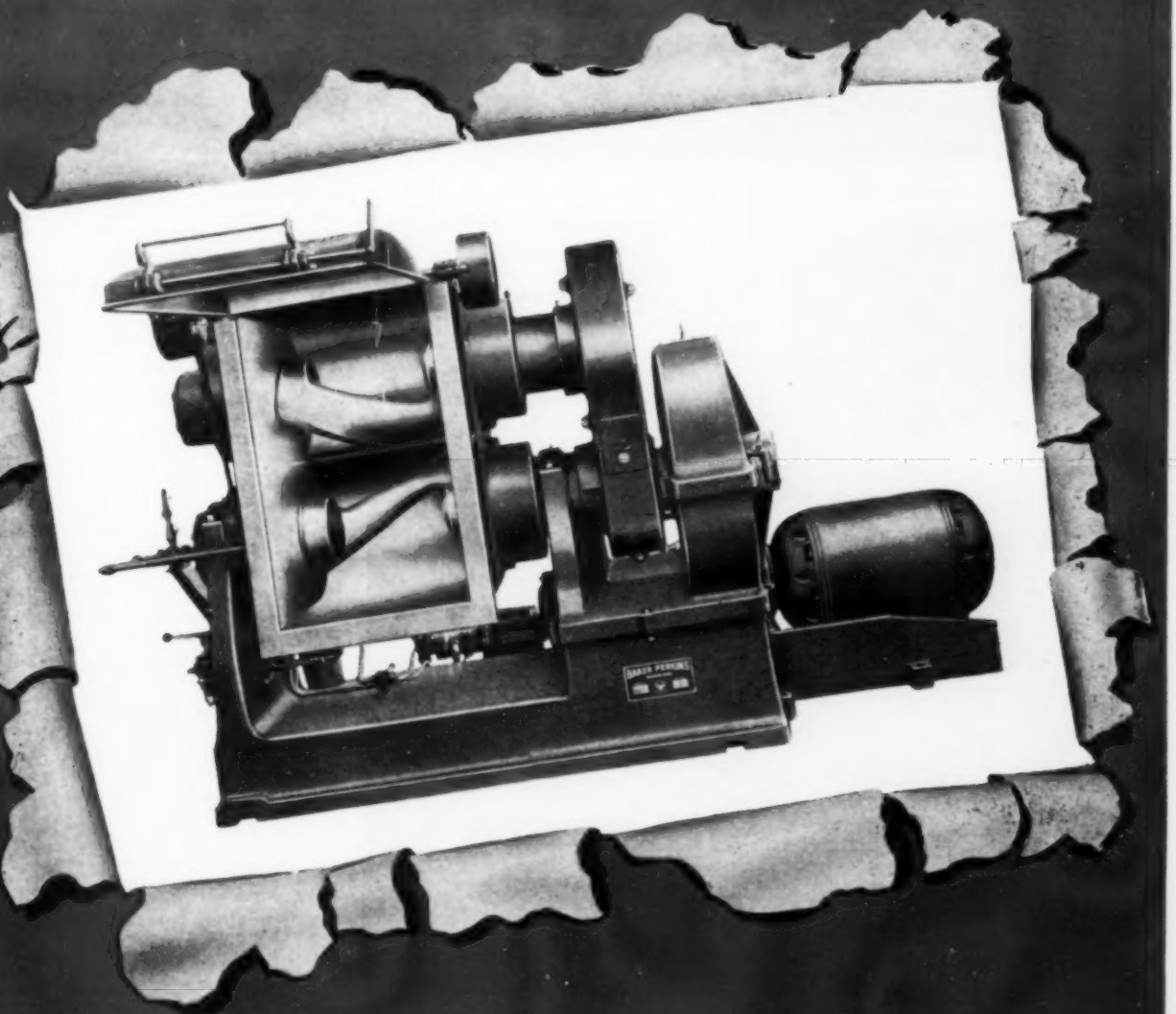
TRONA PRODUCTION FIGURES SHOWN TO INCREASE

In a prospectus issued by the Alien Property Custodian announcing the public sale of 90.5 percent of the outstanding capital stock of the American Potash & Chemical Corp., Los Angeles, data were given to show the growth of this firm's output of chemicals at its Trona, Calif., plant (see accompanying table.) The shares were sold to a group of investment bankers on March 27 for $15,440,884. Currently, it was stated, potash accounts for approximately 40 percent of the company's total net sales in dollars, boron products for about 36 percent, soda ash for approximately 12 percent and salt cake for some 7 percent. In 1944, approximately 32 percent of total net sales

California Producers of Borates and Sodium Salts, 1945

Producer	Plant Location	Products
American Potash & Chemical Corp.	Trona	Soda ash, salt cake, borates
Columbia Chemical Div., Pittsburgh Plate Glass Co.	Bartlett	Soda ash, trona, borates
Natural Soda Products Co.	Keeler	Soda ash, trona
Pacific Coast Borax Co.	Kramer	Borates
United States Borax Co.	Death Valley	Borates
West End Chemical Co.	West End	Soda ash, borates

Baker Perkins Dispersion Mixers



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in dollars was for consumption in agriculture.

American Potash & Chemical Corp. is the only producer of potash on the West Coast. During the past six years the firm's sales of potash, in terms of K_2O, to the western market increased to about 12.5 percent of its total sales of this chemical. It supplies substantially all potash used in agriculture in the area. The company believes itself to be the second largest producer of boron products in the United States and that it produces roughly 40 percent of the borax produced in this country. According to estimates, it also produces roughly 40 percent of the soda ash manufactured on the West Coast, substantially all of which has been disposed of in the western states, principally in California, as well as roughly 17 percent of the salt cake produced in the United States. The major portion of the company's sales of salt cake is made to kraft paper mills in the Pacific Northwest. In addition to crude lithium phosphate and bromine, the firm manufactures a relatively small quantity of refined desiccated sodium sulphate which finds its major outlets along the Atlantic Coast principally for use in the dyeing of textiles and in the standardization of dyestuffs.

In 1943, American Potash & Chemical Corp. completed an expansion to its soda ash and salt cake plant at Trona at a cost of approximately $1,710,000. Other additions to the plant in the last five years, at a cost of approximately $541,000, were for the production of bromine and bromides and crude lithium phosphate and for an expansion in boric acid production. In addition to construction in Los Angeles of a new office building for its own use, estimated to cost $140,000, the company proposes to proceed in 1946 with construction and equipment of a new and enlarged research laboratory at Trona, presently estimated to cost $350,000.

Production of Primary Products by American Potash & Chemical Corp.[1]

	Potash[2]	Borax[3]	Soda Ash[4]	Salt Cake[5]
1935	137,704	78,034	22,458	23,902
1936	171,488	95,915	32,426	45,916
1937	185,584	97,713	39,830	56,652
1938	193,592	103,548	51,054	76,219
1939	189,970	100,690	47,732	79,788
1940	194,187	95,383	51,821	83,874
1941[6]	130,303	62,933	31,312	50,863
1942	193,488	92,071	42,768	80,568
1943	196,817	89,895	54,211	92,855
1944	205,412	97,472	70,120	123,649
1945	202,789	98,794	82,008	121,285

[1] In short tons. From prospectus issued by the Alien Property Custodian, dated Feb. 25, 1946. [2] Muriate of potash, agricultural grade, refined potassium chloride, chemical grade, and sulphate of potash, expressed as 60 percent muriate of potash, agricultural grade. [3] Refined borax, Pyrobor ($Na_2B_4O_7$) and boric acid, expressed as refined borax. [4] Actual production; other tonnage figures calculated from certain factors adjusted from time to time to take care of certain variables. [5] Salt cake and desiccated sodium sulphate, expressed as salt cake. [6] Plant closed 3½ months due to strike.

ALLOYS PILOT PLANT OPERATES AT SHASTA

INITIAL operations have now begun at the pilot plant at Shasta Dam on the Sacramento River for the experimental production of high-quality alloys from metallic ores of northern California and adjacent areas. The unit consists of a direct arc

furnace of the Herault type with a holding capacity of approximately six tons. Power will be delivered over a direct line from the Shasta power plant.

Sponsored jointly by the U. S. Bureau of Mines and Reclamation Bureau, the pilot plant will process the magnetite, chrome and other ores of northern California to determine their value in the production of high-quality alloys needed by western industry. For example, sponge iron made from Shasta County magnetite in the U. S. Bureau of Mines experimental unit at Laramie, Wyo., will be tested for alloying properties in the Shasta electric furnace. William W. Stephens is engineer in charge of the pilot plant.

NEW INDUSTRIAL CHEMICALS FOR THE WEST

SOME 20 major industrial chemicals have been produced commercially in the West only since 1941, a recent investigation on integration of western chemical industries has revealed. Yet, some 30 major chemicals are still not produced in the area at all. By far the greatest deficiency of the West is in the field of synthetic organic chemi-

Table I—Major Chemicals Produced Commercially in the West Only Since 1941*

Formaldehyde
Penicillin
Potassium perchlorate
Phthalic anhydride
Tetrasodium pyrophosphate
Sodium acid pyrophosphate
Glucose (wheat)
Butadiene
Styrene
Hydrofluoric acid, anhydrous
Sodium fluoride & bifluoride
Calcium tartrate, crude
Methyl isobutyl ketone
Potassium metabisulphite
Phosphoric acid, 75% food grade
Aluminum chloride, anhydrous
Monosodium phosphate, anhydrous
2,4-dichlorophenoxyacetic acid
Blood proteins
Certain amino acids

* This list is not intended to be complete, but indicative only.

Table II—Major Chemicals Not Produced Commercially in the West*

Methanol
Synthetic phenol
Urea
Rayon
Butyl alcohol & acetate
Alumina (for aluminum) †
Vinyl acetate & chloride
Phosphorus
Phosphorus chemicals
Nylon
DDT
Ethylene glycol
Freon
Chromic acid & chromates
Sodium bicarbonate
Acetic anhydride
Aspirin
Ethyl acetate
Hexamethylenetetramine
Sulfa drugs
Oxalic acid
Formic acid
Nitrobenzene*
Aniline
Synthetic vitamins
Maleic anhydride
Synthetic dyes†
Titanium dioxide

* This list is not intended to be complete, but indicative only. † With minor exceptions.

cals, and such basic organics as methanol, synthetic phenol, butyl alcohol, ethylene glycol, acetic anhydride and nitrobenzene are still not produced commercially in the region. Tables I and II list some of the more important chemicals in both of the above categories.

ALKYD RESIN OUTPUT TO BE INCREASED

Two new plants for the production of alkyd resins are now going up in California, thus bringing the number of western producers of this resin for sale to eight. The Anaheim plant of General Electric Co. is scheduled for completion during mid-summer, while construction work on the new unit of Sherwin-Williams Co. of California is now getting into full swing. In 1938, the only western producers of this class of resins were Andrew Brown Co. and California Flaxseed Products Co. (See table.)

Other than glycerin, of which there are several producers, the only other alkyd resin raw material made in the west is phthalic anhydride at the new Richmond, Calif., plant of Oronite Chemical Co. This plant, the only one of its kind to use a petroleum raw material, is now reaching full production capacity.

Western Producers of Alkyd Resins for Resale

Producer	Plant Location*
American Cyanamid & Chemical Corp.	Azusa
Andrew Brown Co.	Los Angeles
California Flaxseed Products Co.	Vernon
California Ink Co., Inc.	W. Berkeley
General Electric Co.†	Anaheim
Reichhold Chemicals, Inc.	S. San Francisco
Sherwin-Williams Co. of Calif.†	Emeryville
Specialty Resins Co.	Los Angeles

* All plants are located in California. † Plant under construction.

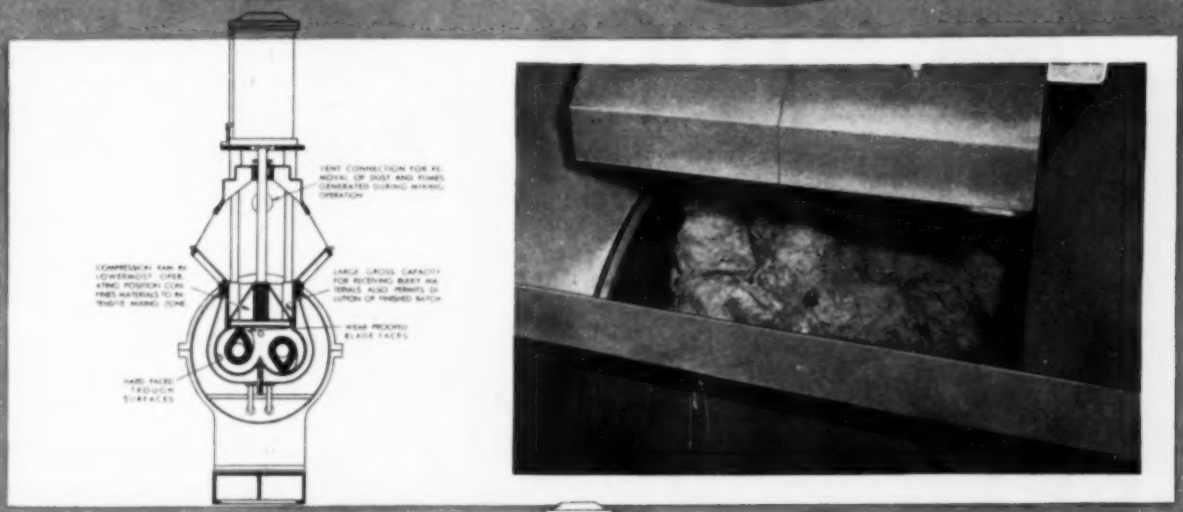
STATE SUES LOS ANGELES ON OWENS VALLEY FLOOD

Charging negligence resulting in permanent damage to mineral deposits, the State of California is suing the City of Los Angeles for damages of $1,000,000 or more as a result of the flooding of Owens Lake in 1938. The case was started during October 1945 at Santa Barbara on change of venue motion by Los Angeles after the city had lost one suit in the Owens Valley area. The State has recently concluded its case at Santa Barbara.

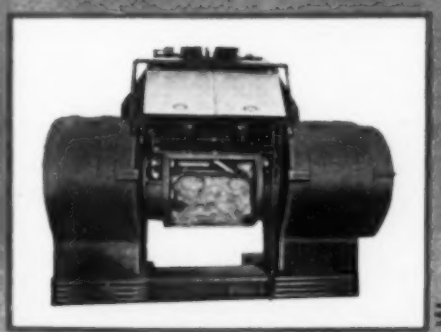
Owens Lake was at one time a saline body of water at the end of the Owens River in Inyo county. When the Los Angeles aqueduct was placed in operation in 1913, water from the Owens River was diverted from the lake. This gradually dried up, leaving a delta of mud in the river bed at the entrance. Prior to the drying up of the lake, chemical firms refined commercial soda ash from the brine. When the lake became dry, they changed their processes accordingly and Natural Soda Products Co began using a "dry" process. Shortly after these operations got under way in 1938, a flood was "permitted" by Los Angeles negligence, the State contends, to rush down Owens arroyo and wash the mud delta into the lake so as to cover it with a layer 2-3

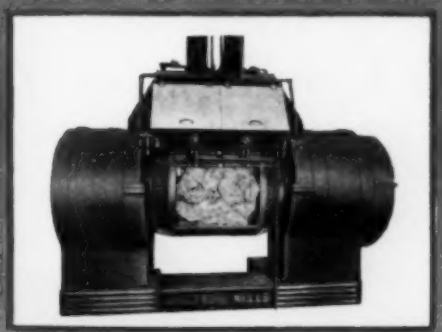
RAPID CHARGE AND DISCHARGE... One of the Outstanding Features of STRUTHERS WELLS

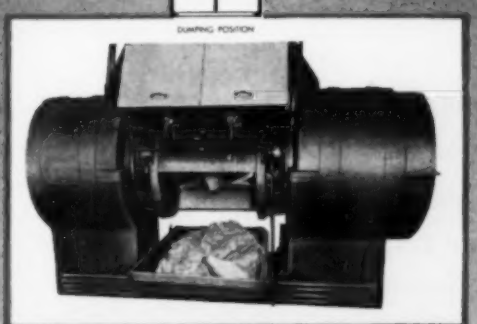
NORTHMASTER INTENSIVE MIXERS



These are actual photographs of a Struthers Wells Northmaster Intensive Mixer which was recently built and installed for a large manufacturer.







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in. thick. The lake became dry again in 1940, but this mud layer or some other resultant from the flood evidently interfered with the circulation of warm surface brines with the cooler "deep well" brines from which sodium carbonate is extracted.

As a result of this or some other factor claimed to arise from the flood, it appears that the alkali content of the deep well brines has been lowered from about 140 to 100 g. per liter, expressed as Na_2O. Since the chemical firms were lessees of the State, which collects a royalty of 25c. per ton, the State is claiming damages, which may possibly be permanent, to the commercial value of the saline deposits. Owens Lake is worked for soda ash and trona by Columbia Chemical Div., Pittsburgh Plate Glass Co., at Bartlett and by Natural Soda Products Co., a subsidiary of Wyandotte Chemicals Corp., at Keeler. The latter operator sued the city of Los Angeles in 1940-41 and, after the case was carried to the California and United States Supreme Courts, won a verdict of $153,000 as damages covering a period of a few years.

ENAMEL FIRM EXPANDS PLANT FACILITIES

A NEW building program has recently been undertaken by U. S. Porcelain Enamel Co., Los Angeles, that will materially increase the firm's production facilities. Included in the $150,000 program is a 75 x 130 ft. addition to the company's metal fabricating plant that will double its present size. Another addition will double the size of the pickling room where the metal is cleaned in 8 percent H_2SO_4 prior to enameling. Although the main line of the company is porcelain enameled signs, it also does metal enameling work in the process equipment line. The expansion will mean an increased consumption of chemical opacifiers and fluxes for enamels in southern California.

STEFFEN WASTE UTILIZATION PLANS PROGRESSING

WITH construction work now well under way on the $2,500,000 amino products plant of International Minerals & Chemicals Corp. at San Jose, Calif., plans for concentrating Steffen waste water from beet sugar operations, which will be the raw material for the new monosodium glutamate plant, are becoming more tangible. Latest announcement in this connection is the project of the Amalgamated Sugar Co., Ogden, Utah, to concentrate the Steffen waste liquor from its Nyssa, Ore., beet sugar factory for shipment to International Minerals & Chemical Corp. in California. While the cost of the project has not yet been announced, it is expected to be substantial.

It is hoped that production of Steffen concentrate at the Nyssa factory can be started this fall, but strikes and the current shortage of materials may delay operations, according to Roy H. Cottrell, vice president of Amalgamated Sugar Co. The Nyssa sugar plant, erected in 1938, is at present probably the most modern equipped plant of its kind in the United States. The unit produced 905,000,000 lb. of sugar in the campaign just closed. The firm has six beet sugar factories located in Utah, Idaho and Oregon.

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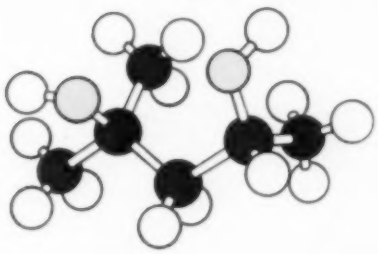

HEXYLENE GLYCOL[$(CH_3)_2COH.CH_2CHOH.CH_3$] is an excellent *high boiling solvent* (199°C).

Completely miscible with water, alcohols and ketones generally, aromatic and petroleum hydrocarbons and such materials as carbon tetrachloride, it is highly valuable as a *coupling agent* for otherwise immiscible liquids.

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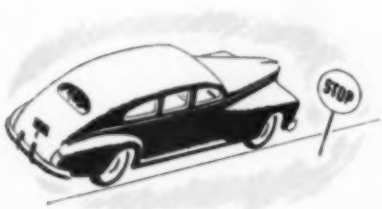

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PROPERTIES

Specific Gravity at 20/4° C.	0.922
Boiling Range at 760 mm.	195-199° C.
Flash Point, Tag open cup	205-210° F.
Vapor Pressure at 20° C.	0.02 mm. Hg.
90° C.	7.68 mm. Hg.
Refractive Index, $N\frac{20}{D}$	1.4274
Latent Heat of Vaporization	12,900 cal. gram mole at boiling point
Solubility at 20° C.	Completely miscible in water, acetone, toluene, carbon tetrachloride and octanes
Pounds per U.S. Gal. at 20° C.	7.68
Molecular Weight	118.17

For further information and uses of Hexylene Glycol, write for Technical Bulletin #SC:46-13.

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NEWS FROM ABROAD

NEAR-CAPACITY PRODUCTION OF CHEMICALS HELPS TO OFFSET COST INCREASES IN GREAT BRITAIN

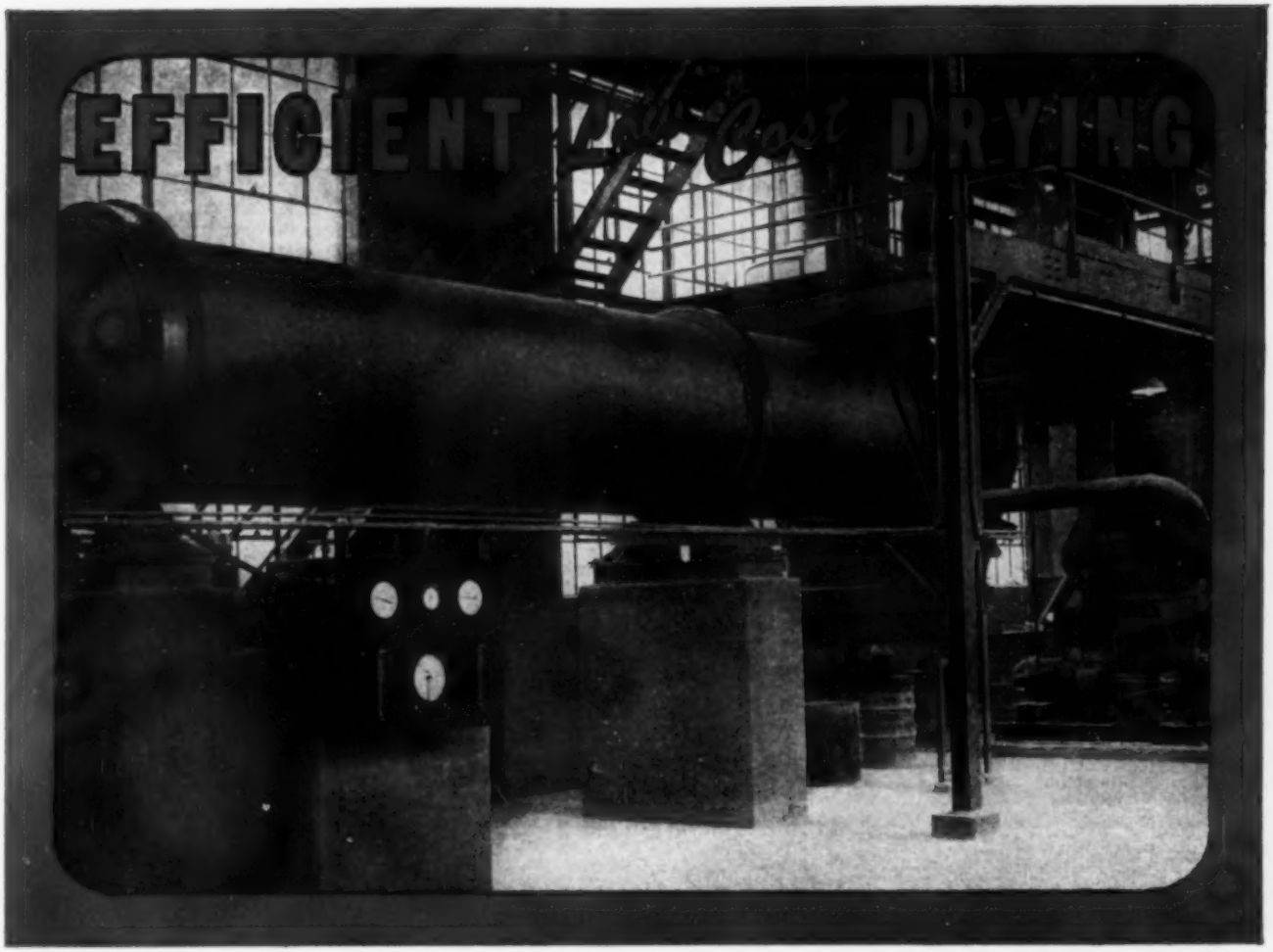
Special Correspondence

NEAR-CAPACITY production is needed in most chemical trades to cope with the very brisk demand, and there is every likelihood that official or private rationing of consumers, priority allocations, substitution and other wartime expedients will continue to some extent for a considerable time to come. True, the chemical industry is in many ways better placed than others. There is no shortage of raw materials, though coal stocks were dangerously low and imported fertilizer materials are insufficient. The labor force is equal to the highest wartime figure and much higher than before the war. Transport, containers, key personnel and other keenly-felt bottlenecks have been overcome, and plant reconversion problems of other industries have been largely avoided thanks to the high level of production and attention to maintenance during the war.

On the other hand, there is no plant or labor reserve to draw on in an emergency, and factory extensions and re-equipment take a long time to effect. Raw material prices tend to rise, and the cost of new machinery may be anything up to twice the prewar cost. Wartime taxation made accumulation of proper financial reserves difficult, and wages would be higher but for the government's food subsidies. Nevertheless the postwar economics of the British chemical industry are viewed with fair optimism.

The balance sheets of all important manufacturers show larger profits for 1945, and some companies have paid bonuses to their shareholders in addition to an unchanged dividend, thus marking the dissolution of hidden reserves intended to cover the special wartime risks. Most chemical and allied firms, however, heeded the government's warning and ploughed their excess profits back into their works.

The accounts of Imperial Chemical Industries, Ltd., largest by far among British chemical manufacturers, may be regarded as typical. The profit balance rose to £8,554,867 from £8,035,006. The central obsolescence and depreciation reserve receives a special additional appropriation of £1,500,000 (£1,000,000 in 1944.) and the carry forward is increased to £1,337,280 (£1,145,274 in 1944.), while the dividend is left unchanged at 8 percent. The cautious financial policy of which these figures furnish an example is due chiefly to three factors: the government's discouragement of extra profit distributions, the expectation of large financial needs for extensions and



The General American Louisville Counter-Current Direct Heat Dryer (for operation at either high or low temperatures) offers chemical process plants a continuous, efficient, low cost means of drying many materials, such as:

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replacements, and the quickening pace of technical progress with the consequent need of earlier writing down of plant book values.

Increased provision for obsolescence and depreciation is to some extent if not fully offset by full or near-capacity utilization of plant and low interest rates, but so far, it seems, British chemical manufacturers prefer to treat the saving on this count as an extraordinary gain to be used for strengthening reserves rather than to revise the calculation basis.

RISE IN COSTS

With the present pressure of demand there is, of course, no need for close calculating and accurate assessment and allocation of all cost elements, nor would it indeed be prudent to base future policies on the unsettled conditions of today. There is no doubt, however, that wartime changes have brought about huge changes which will have to be taken into account. All cost elements have risen, and not all have as yet reached the limit of possible inflation. But the pace and magnitude of the increase has not by any means been uniform. Wage rates have risen substantially, but the increase has to some extent been offset by perfection of technical processes and increased employment of female labor. Nevertheless present wages present an incentive for mechanization.

The higher cost of plant and equipment, it was stated, is to some extent offset by lower interest charges, while those firms which took over government-owned war factories for private post-war operations probably acquired their plants at less than the cost of new works. There are no such redeeming features, however, to make up for the increase in the cost of raw materials and fuel, and it may be assumed that once the full implication of high commodity prices is realized special attention will be paid to substitution as a means of cost reduction.

The past month has brought a substantial revision of non-ferrous metal prices. While the quotation for aluminum was brought down from £85 to £67 per long ton (compared with £100 in wartime), copper has risen by £10 to £72, lead by £6 to £45 and zinc by £8 to £39.5s. The prices of copper and lead have now been brought up to world market level, and this seems indeed to be the reason of the move.

After having taken over the output of Empire producers at prewar world market prices plus changes in costs during the war, the Ministry of Supply is now buying metals at negotiated prices and raises its quotations for British consumers whenever this becomes necessary in the light of the actual cost of the metals supplied. The system of subsidies, which were fully justified during wartime when the government was practically the only buyer of metal manufactures, is thus abandoned, but the system of bulk purchases on government account will be retained for most of the commodities whose prices were fixed on such organized markets as the London Metal Exchange before the war.

Decontrol of import commodities has made further progress during the past few weeks—bitumen, earth colors, medicinal herbs provide examples—but where mate-

rials are in short supply on the world market, the government seems to prefer its system of bulk purchasing and quota allocation, though the latter may be varied where essential demands can be met fully only if other users accept substitutes. As far as imports of manufactures are concerned, de control has been rather slower, but it has brought an important step forward by plans to facilitate the reopening of prewar trade connections in goods for which no import licenses were until recently granted.

Overseas manufacturers of such articles are to be allowed to sell approximately 20 percent of the prewar trade in the British home market, though they will be subject to similar price and other limitations as British manufacturers of comparable goods. This step has no doubt been considered as a means of facilitating the resumption of normal trade, but it is also due to the need of supplementing British production in certain directions. Necessities for the building trades, in particular, will soon have to be imported in substantial quantities to prevent a slowing down of the rehousing drive, and American paints will be among these imports if Congress approves the loan for Britain.

EXPANSION PROJECTS

The past month has brought further news of plant extension projects in various fields of chemical manufacture. Not unnaturally, many of these are concerned with plastics, but from the large amount of news on new projects and proposed extensions of existing works it is difficult to gage just how much additional production these projects will supply. All producers wish to maintain their position in an expanding market, but some of the oldest and best informed firms seem to feel doubtful about the permanency of the present boom. In the rayon industry, on the other hand, where the bulk of production is supplied by two big firms, plans have been laid for a very substantial long-term expansion.

While British Celanese has not announced any detailed plans (the company will expand both in the rayon and in the plastics field), Courtaulds proposes to invest a substantial proportion of its £40,000,000 of liquid resources (two-thirds of which originated from the sale of the company's U.S. subsidiary, American Viscose Corp.) in two new rayon yarn factories in West Cumberland and Northern Ireland, a rayon staple factory near Dundee in Scotland, an additional staple fiber production unit in North Wales, and a new acetate yarn and fiber unit at Preston in Lancashire, while British Nylon Spinners Ltd., a subsidiary jointly owned with I.C.I., is building in South Wales, and another affiliated company, British Cellophane Ltd., is completing the installation of new equipment designed to give increased output at lower cost.

Courtaulds' expansion policy shows features typical also of other chemical productions. Careful siting with due regard to raw materials, consuming markets and, especially, labor; horizontal spread and dispersal to reduce transport costs to a minimum; and specialization and careful attention to plant and unit size to permit

economic operation at various levels of demand.

While Courtaulds has entered the field of textile machinery construction, it has not been found advisable to enter chemical manufacture proper. Nor indeed do firms in other chemical-consuming industries intend to build chemical works of their own. The complete absence of any such plans may be regarded as evidence that most types of chemicals are reaching British consumers in adequate quantities and at reasonable prices from established manufacturers.

GREECE GETS SULPHUR AND COPPER SULPHATE

A SHIPMENT of 2,900 tons of UNRRA sulphur recently reached the Greek port of Patras, forming a considerable part of the total Greek program for sulphur of 11,200 tons. Together with supplies of copper sulphate to be shipped to Greece by UNRRA, it is expected that the vine and vegetable growers of that country will have their needs covered for 1946.

Another source of sulphur for Europe is suggested by a report from Eritrea which says an attempt is being made to develop sulphur production from the mines at Mersa Fatma, south of Massawa. It is hoped to ship the sulphur out by sea to avoid high land transport costs.

COURTAULD'S SPONSORS RAYON RESEARCH

GIFT of $240,000 to Leeds University's department of textile industries, to increase facilities for teaching and research in rayon technology, was recently announced by Courtauld's, Ltd., the British rayon producer. The university will erect a new building with the money and equip it with the most modern machinery. The gift is part of a $2,000,000 fund Courtauld's set aside for such purposes in 1944 and follows a similar donation last year of $480,000 to the imperial College of Science and Technology at South Kensington.

EXPANSION PROGRAMS FOR SOUTH AFRICAN INDUSTRIES

IN A message from Johannesburg, the McGraw-Hill World News Bureau reports that South African affiliates of Imperial Chemical Industries will embark on a broad and long-range program of manufacturing expansion. The statement is credited to Lord McGowan, chairman of ICI. The affliated companies will make cyanides for gold mining and a large range of paints, varnishes, and leather cloth. Superphosphate output—South Africa's chief need in fertilizers—will be increased to 500,000 tons a year.

NEW PROCESS FOR POTASSIUM CHLORATE IN INDIA

A REPORT from New Delhi, India, states that Indian chemists have developed what they believe to be a new process for making potassium chlorate. Chlorine is passed through a slurry of lime to obtain calcium chlorate from which, in turn, potassium chlorate is obtained. The process is now

being used on a commercial scale by the Mettur Chemical and Industrial Corp.

RUSSIAN DANDELION GIVES HIGH RUBBER YIELD

Soviet self-sufficiency in rubber is reported due chiefly to the high rubber content and quality of kok-saghya, the so-called Russian dandelion. The natural rubber from this plant is mixed with synthetic rubber in 10 percent to 20 percent proportions. The Russian dandelion will yield from 90 lb. to as much as 200 lb. per acre. Russian botanists have experimented with some 300 plants with varying degrees of rubber content and have selected six as being of sufficient value to warrant production. By 1941, Russia was producing enough plant and synthetic rubber to supply virtually all her military and civilian needs.

NORSK HYDRO IS WORKING AT FULL CAPACITY

Working at full capacity and expecting to produce in excess of 88,000 tons of nitrogen this year, Norsk Hydro, according to a report from Oslo, Norway, finds itself in a much more favorable position than the rest of the Norwegian chemical industry. Since most of the others are owned by large international corporations Norwegian production has to be geared to that of other plants aboard. The tremendous wartime expansion of aluminum production in outside countries has hit the Norwegian aluminum industry particularly hard. Normally 90 percent of Norway's aluminum production was for export.

BELGIAN ECONOMIC MISSION VISITS SOUTH AMERICA

According to the McGraw-Hill World News Bureau, a Belgian economic mission recently arrived in Santiago, Chile, for the purpose of selling large orders of Belgian drugs and chemical products as well as light metal products, railroad equipment, and other goods. The mission is headed by a representative of the Belgian Ministry of Economic Affairs and a spokesman for the group said Belgium is interested in buying Chilean copper, nitrates, and other goods and would export Belgian goods in return.

STRIKES RETARD INDUSTRIAL PROGRESS IN CHINA

In his recent report on the economic rehabilitation of China, Dr. Wong Wen-hao, Minister of Economic Affairs, said progress thus far has not been satisfactory. China's present difficulties are what might befall any other country after a long exhausting war. The government, however, is making every effort to increase shipping tonnage and also to supply fuel and electric power. It has organized a China Textile Industries, Inc., a Silk Industrial Co., and a Marine Products Co. to help develop these essential industries. Owing to the shortage of raw materials and transportation facilities, the resumption of production in factories taken over from the Japanese has been progressing rather slowly. The fluctuation of commodity prices and the continuous labor strikes also have slowed production.

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SYNTHETIC LUBRICANTS FROM TETRAHYDROFURAN

It has been found that, by a complicated procedure, tetrahydrofuran will polymerize in the presence of a catalyst to compounds having properties desirable in a lubricant. During a research which apparently covered about four years, a series of catalysts was developed for the polymerization. The best of these, for large scale production is the ferric chloride-thionyl chloride complex. Tetrahydrofuran polymerizes by a free radical or ionic chain mechanism.

The polymers range from liquids at room temperature to crystalline solids with a melting point about 60 deg. C. The products are soluble in aromatic hydrocarbons, in chlorinated aliphatic hydrocarbons, and in many ethers, esters and ketones. The solubility decreases with increase in molecular weight.

Consistency of the polymeric products may be roughly grouped according to the number of carbon atoms per molecule as follows:

Up to 16 liquid at room temperature.
16 to 25 vaseline like.
25 to 50 waxy.
50 to 100 tough wax to brittle.

These polymers are unstable to oxidation. Stability in operation is achieved by the addition of small amounts 1.0 to 3.0 percent of phenyl B-naphthylamine.

In practice for lubricant production, tetrahydrofuran is always copolymerized with ethylene oxide or one of its derivatives such as propylene oxide or epichlorhydrin. The copolymerizing monomers tend to keep the polymeric product liquid over wider temperature differences. The more branched the chain of the oxide additive the broader is the liquid range of the polymer.

These polymers have also been tried in applications other than lubricants. Products containing 18 to 71 carbon atoms per chain are compatible with buna S and cause a softening which accelerates sheeting in the processing of this synthetic rubber. Polymers containing less than 30 carbon atoms per molecule give no decrease in the strength of the compounds buna S. Above 30 there is a decided lowering in the strength of the rubber. Tetrahydrofuran polymers have also been used as a substitute for wool-fat as an aid in spraying buna S compositions for certain applications. These same polymers have also been used as substitutes for whale-oil for treating leather and as lubricants for synthetic fibers in spinning operations.

It is essential in this process that all reagents be carefully dried before use. This is mandatory for control of the reaction and for best yields. The presence of water hydrolyzes the catalyst giving rise to acidic components.

The catalyst for a typical preparation is prepared previous to its utilization in the process by mixing 12 liters tetrahydrofuran,

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5 kg. ferric chloride, and 3 kg. thionyl chloride.

During reaction of these, sulphur dioxide is lost and the product, a crystalline mass, is isolated and charged back to the reaction so that the molecular concentration of the catalyst based on the total product (Engine lubricant M 620) is as follows: tetrahydrofuran, 100; ethylene oxide, 50; thionyl chloride, 8; ferric chloride, 0.3.

The apparatus used is an iron kettle, equipped with an agitator and open to the atmosphere through a reflux condenser. The kettle is jacketed for cooling. The tetrahydrofuran and ethylene oxide are mixed and fed to the catalyst as such a rate as to maintain a temperature of 28 to 30 deg. C. Approximately 90 to 95 percent of the tetrahydrofuran enters into the polymer during reaction. The crude oil is washed free of iron salts or corrosion by treatment with aqueous sodium bisulphite, the washed oil is then treated with sodium methylate under reflux to replace the terminal chlorine groups with methoxy groups, then neutralized and stripped of any remaining tetrahydrofuran, water and low boiling compounds by a vacuum distillation.

The involved process of manufacture, the limited availability of necessary raw materials and cost would preclude any large-scale production of these lubricants in competition with refined natural hydrocarbons.

Digest from "The Preparation of Tetrahydrofuran Polymers as a Synthetic Lubricant for Metals," by F. H. Roberts. Publication Board Report 2537.

FIRE-EXTINGUISHING FOAM

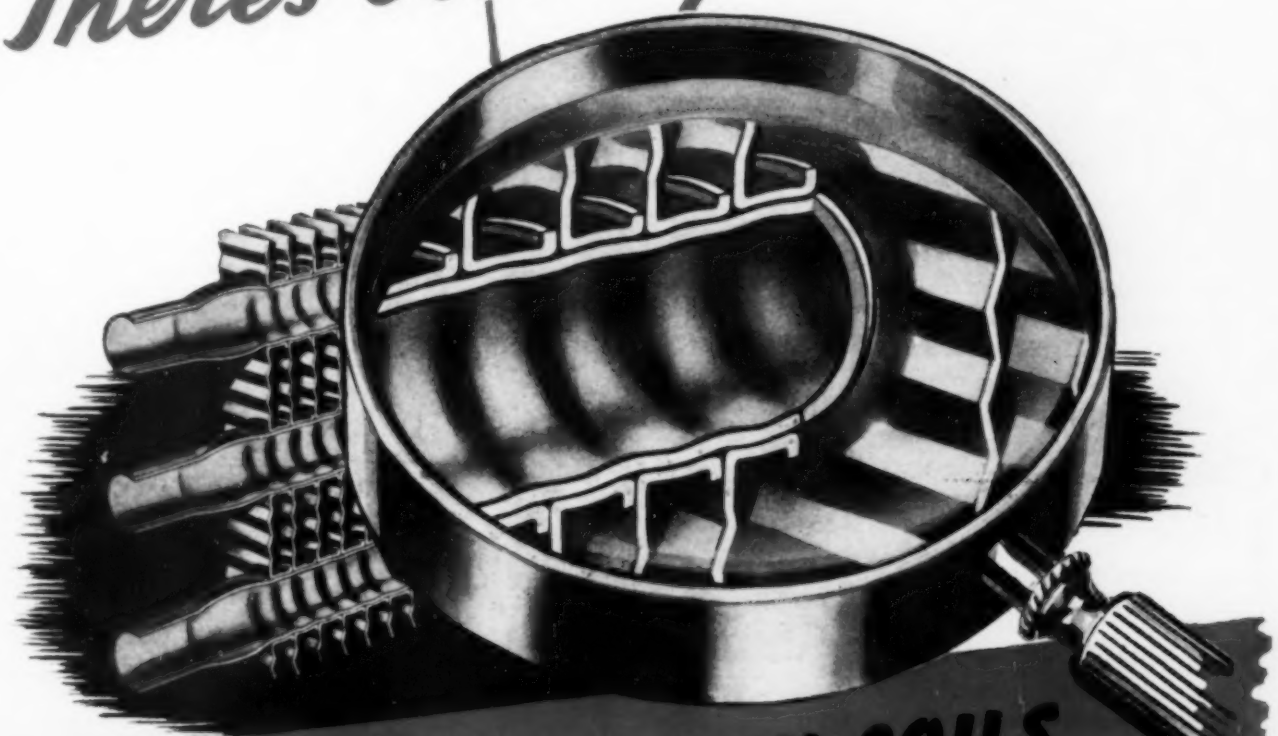
AT VARIOUS industrial plants visited, the best mechanical air-foam solution used was said to be that manufactured by Chemische-Fabrik von Dr. Richard Sthamer, Hamburg. This firm's prime business was the manufacture of saponine to be added to beers to increase their foam stability. In 1943 they began to develop a method for the manufacture of a solution that could be used with water to make fire-extinguishing air-foam. The manufacturing process consists of digesting hoof and horn meal of about 2 mm. size particles with calcium oxide (CaO) in a pressure cooker at between 120 and 130 deg. C. This requires from ¾ to 1¼ hr. depending on the raw material. At this stage insoluble material is removed by filtration with 60 deg. Bé. sulphuric acid to a pH of about 5.8. It is again filtered and the filtrate concentrated until a specific gravity of 1.14 to 1.15 is obtained while near its boiling point. Ferrous sulphate is then added (5.75 kg. per 1,000 liters of solution). Sodium benzoate is added also (11.25 kg. per M liter solution). It is then cooled and filtered ready for shipment. Six to eight percent of the solution is added to water before the incorporation of air to create the foam.

Digest from "Report on Fire Extinguishing Equipment Methods and Manufacture in Germany" OPB Report No. 439 by Charles A. Getz.

CALCIUM AND SODIUM PERMANGANATE

SODIUM and calcium permanganate were manufactured at Hollriegelskreuth from potassium permanganate by an ion-exchange process: potassium permanganate is passed through a sodium or calcium zeolite (alum-

There's Always a Reason



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mo silicate) giving sodium or calcium permanganate; the zeolite is regenerated with sodium or calcium chloride. The zeolite used is a product of Permutit A. G., Berlin known as "Permutit G." Batches of 4,000 liters of water, containing 290 kg. of potassium permanganate, at 35 deg. C., pass through towers filled with zeolite particles; ten batches (i.e. 40,000 l.) are then evaporated to 2,000 l. in an iron vessel, at 100 mm. pressure and about 60 deg. C. The unchanged potassium permanganate (which may be as little as 5 percent) separates and is filtered. To ensure its complete removal the solution is cooled to –10 deg. C. and filtered again. The product is then diluted to the desired concentration and stored in iron vessels. The plant, which was erected in 1940, can produce 60 tons per month of permanganate solution (density 1.5); this was sold at RM 3 per kg., though from the cost accounts it appears that the cost of manufacture averaged about 0.8 per kg.

Digest from "CIOS Trip No. 215" OPB Report No. 80 by J. McAulay, D. B. Clapp, V. W. Slater and K. A. Cooper.

Before, during and after the demolition of a German military explosives plant at Ebenhausen, Bavaria. (Photographs from A. B. Newman, Econ. Div. OMGUS)

Materials of Construction in Bead Catalyst Plant

IN THE April issue of *Chem. & Met.* there was published an article describing in detail the process by which the Socony Vacuum Oil Co. at its Paulsboro, N. J., refinery produces bead catalyst for use in the catalytic cracking of petroleum. Our purpose here is to discuss materials of construction in the bead catalyst plant.

PROCESS DESCRIPTION

Briefly, the process is based on the fact that when solutions of sodium silicate and an acid are mixed in the proper proportions, a gel is formed. Into this gel a catalytic material, such as active alumina, is chemically bound. The gel is formed in the shape of spheroids by causing the mixed gel-forming solutions to flow downward onto the apex of a fluted cone located at the top of a "forming tower." The flutings divide the stream into sixty separate streams which flow off the bottom of the cone into a bath of light mineral oil. During their descent through the oil the streams break into droplets and gel in that form. Green beads so formed go through a series of "wet processing" operations in which they are treated with hot water to control their density, with aluminum sulphate solution to displace zeolitic sodium by base exchange, and with cold water to wash out all soluble salts. Removal of the water of gelation leaves an extremely porous, active and durable residue formed in a highly desirable shape.

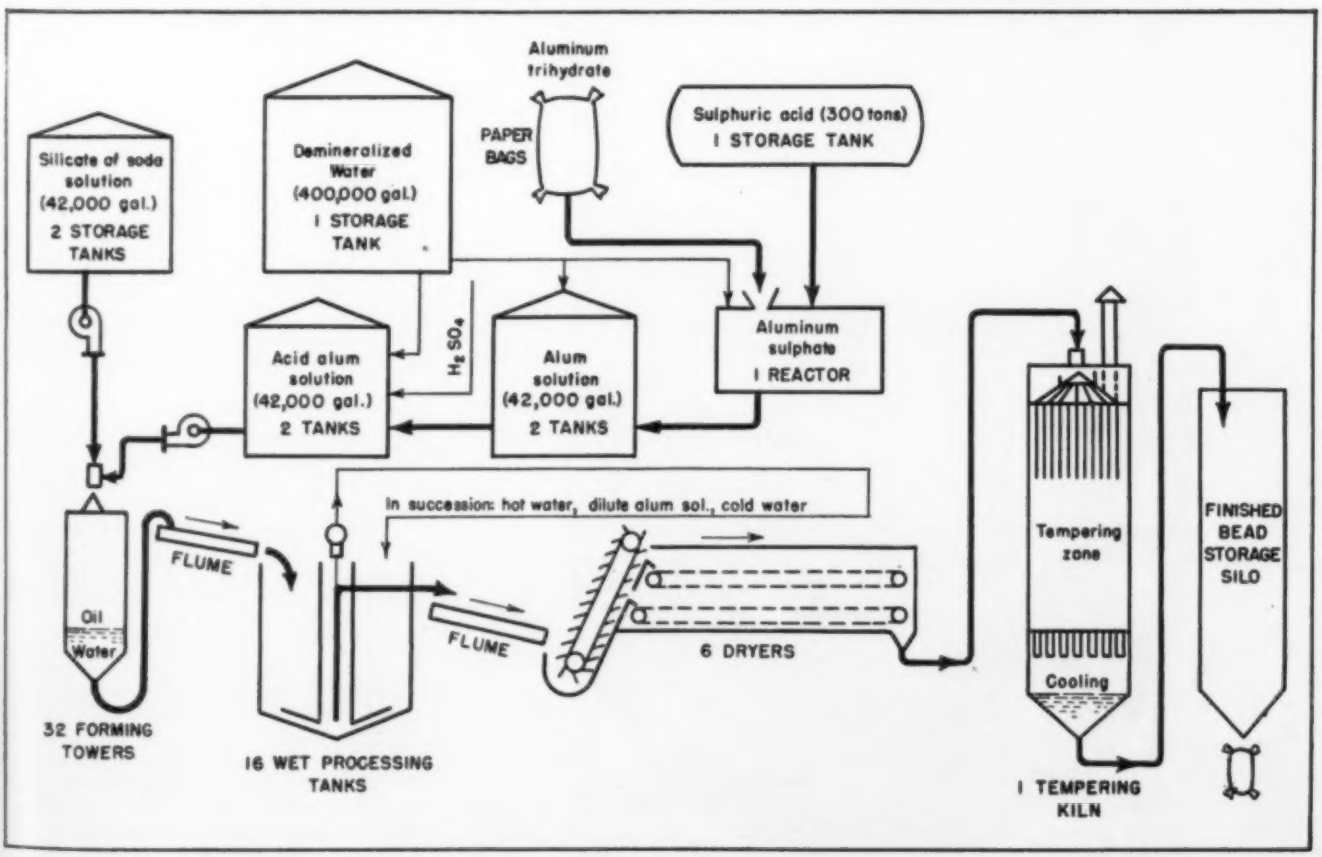
RAW MATERIALS

Concerning the raw materials, silicate of soda, demineralized water, and sulphuric acid are stored in steel tanks; aluminum trihydrate is handled in paper bags. In general it may be stated that sodium silicate solutions present no corrosion problems and are handled by iron and steel equipment, including tanks, pipelines, pumps, valves and the electronic rotameter controls used to meter it to the mixing head above the fluted cone of the forming tower. The use of dilute acid-alum presented the real corrosion problems.

ALUM REACTOR

First step in the preparation of the gel-forming solutions is the manufacture of aluminum sulphate from aluminum trihydrate and sulphuric acid. This reaction is carried out in a lead-lined steel tank 17½ ft. in diameter and 7 ft. deep provided with a suitable agitator. The aluminum ore is added to a 50 percent sulphuric acid solution; the reaction is exothermic and is maintained at 240-260 deg. F. by the rate of addition of ore. The reactor is heated and cooled two or three times a day. Originally the tank was lined with ¼-in. chemical lead; after eight or ten months the lining had so sagged and warped that it had to be replaced. Failure of the first lining may well have been due to insufficient strapping, because the second lining, ⅛-in. tellurium-lead strapped every 2

Simplified flowsheet of process for manufacturing bead catalyst (Socony Vacuum Oil Co.)



ft. on sides and bottom, has shown no signs of creep after more than a year.

The original agitator was a lead covered paddle type and it too suffered under the conditions of high temperature and intermittent heating and cooling. On several occasions the lead cover came off, the bolts holding the paddles were corroded away, and the paddles fell off.

LEAD USED EXTENSIVELY

Agitation is now accomplished by another means, eductor mixers (illustrated *Chem. & Met.*, April 1946, p. 95). All parts of the eductor system are made of bronze (88 percent copper, 10 tin, 2 lead), except for the suction standpipe which is lead. Bronze is used for the eductor nozzle and casing, piping, valves, and pump; brass in these same applications suffered severe corrosion by dezincification. Standard practice in aluminum sulphate reactors is to apply heat by means of lead steam coils. In the bead catalyst plant however heating, and the extra benefit of some agitation, is provided for by the use of direct steam and "noiseless heaters." These steam jets, like nearly all the fittings inside the reactor, are made of bronze.

Of the six 42,000-gal. tanks (see flowsheet), the two handling sodium silicate are steel and the four handling aluminum sulphate are lead-lined steel; all are tile covered for thermal insulation. The 20 percent alum produced in the reactor is pumped to the "alum solution" tanks where it is diluted to 10 percent. Part of this solution is used later on in the base-exchange operation, which is one stage in "wet processing" the formed beads. The rest of the 10 percent alum solution is used in the preparation of one of the gel forming solutions; it is pumped to the "acid-alum solution" tanks where treated water and sulphuric acid are added to form a solution containing less than 5 percent aluminum sulphate, less than 5 percent sulphuric acid, and more than 90 percent treated water. The 10 and 20 percent alum solutions are handled readily by lead, which is the construction material for pipelines, valves, and fittings; pumps are Worthite; eductor mixers are bronze.

ACID ALUM SOLUTION

After the alum solution has been diluted and acidified with sulphuric acid in the acid-alum tank, the solution becomes extremely corrosive. As noted before, the acid-alum tank itself is lead lined steel and its eductor mixer is bronze. The pipelines carrying acid-alum to the mixing head are lead; pumps in this line are Worthite, which has performed well in the service. When originally installed, a pressure control valve and rotameter flow control valves were bronze throughout; in less than a year these valves were severely corroded. The plug, seat, and rod of the pressure control valve were replaced with parts machined from Lucite in the refinery shops. Working parts of the rotameter flow control valves were similarly replaced by Lucite. The first rotameter bobs were stainless steel and they corroded badly; the present lead and bronze bobs are fairly good; Worthite is preferred. The old bronze valve bodies were put back in service, with the expectation of replacing them after a total service life of two or three years. The sum total attitude toward bronze in the dilute acid-alum service is that it will do for parts

American Airlines had a shielding problem

"American Metal Hose" *found the answer*

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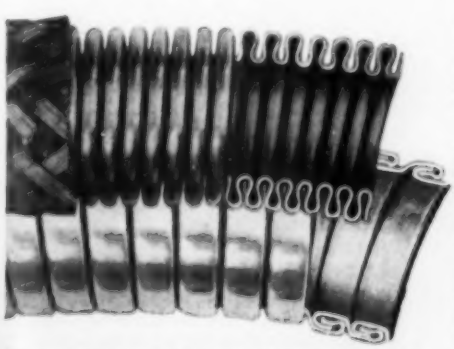
THE SOLUTION:

The answer to these difficulties was provided by the HTCD Shielding Conduit developed by the American Metal Hose Branch of The American Brass Company. Here is a strong, tough, corrosion and vibration-resistant, moisture-proof flexible metal tubing constructed of interlocked stainless steel core, with a covering of two specially-woven layers of tinned copper wire braiding, with brass ferrules, stainless steel nuts, and, finally, a molded Neoprene jacket.

THE RESULT:

American Airlines' flight-testing of this new shielding conduit revealed electrical characteristics never before approached in practice. After 3,712 hours and 42 minutes of operation, the conduit was in such excellent condition that tests were discontinued and it was accepted as standard. In addition, detailed cost studies revealed that the new shielding conduit cost approximately *half as much* per hour of operation as that previously used—and its ultimate life is still unknown.



For practical industrial applications of American Seamless Flexible Metal Tubing and Interlocked Flexible Metal Hose, illustrated above, write for Publication SS-50.

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In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

not requiring close tolerances; Lucite has been a valuable substitute for such parts.

PLASTICS RESIST CORROSION

Connections to the mixing head are flexible Saran (vinyl plastic) tubing and Saran fittings; it has given no cause for complaint and has, in fact, solved a serious problem of leaking around threaded bronze joints. The mixing heads are silicon bronze. These have been quite troublesome, not because they corroded, but because the castings were porous (perhaps uncommonly so) and the solution seeped through. To stop seepage the castings were impregnated with a phenolic resin and this treatment, though it did not completely remedy the condition, was sufficient to permit the continued use of the mixing heads.

The fluted cone distributors are made of plaster of paris and are entirely satisfactory except for the short life of the thin anti-wetting wax coating originally applied to the cone surface to prevent gel adherence (after the solutions are mixed, the time of gelation is only a few seconds). The wax wore off in spots necessitating replacing and redipping all cones daily. After considerable search, the problem was solved by the use of Amercoat resin paint. This material had superior anti-wetting properties, was more resistant to wear and increased cone life nearly thirty times.

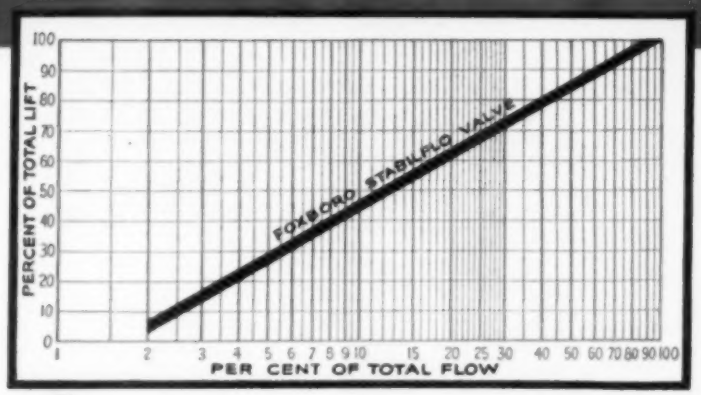
The forming tower is lead lined; the bead discharge line is lead; and the flume to the wet processing tanks is wax coated steel. The wax has worn off of large areas of the flume but the exposed steel has not been corroded to any appreciable extent; apparently a tenacious white surface coating that forms on the exposed steel furnishes a measure of protection. However, the service is not severe; the water which sluices the freshly formed beads out of the forming tower and up into the flume is wash liquor from one of the wet processing operations and has a pH of around 8 or 9.

WET PROCESSING

Each of the 16 wet processing tanks is made of reinforced prestressed concrete, impregnated with wax on the inside to prevent acid leaking. This wax impregnation is serviceable and rather uncommon. Impregnation is carried out as follows. The tank must be dry and smooth; a wire brush is satisfactory for removing rough spots and lumps that would project through the coating. A microcrystalline wax, Petrocene C, was used because it was not expensive and has a high melting point, 165-170 deg. F. Molten wax at 300 deg. F is sprayed on the concrete wall. Deposited wax is remelted with a flame torch (a long yellow oxyacetylene flame is satisfactory) so it can soak well into the concrete. Three or four coats are sprayed and flamed in this manner to build up a coat about 1/16 in. thick. One gallon of wax covers about 100 sq.ft.

Of the several liquors circulating through the wet processing tanks, the 10 percent alum solution for base-exchange is the only one which need be considered corrosive. The following materials give good service in the various components of the wet processing system: Stainless steel (18-8) wire-screen strainers over the effluent liquor outlets, lead piping and valves, bronze pumps and valves, wooden slatted platforms to sup-

Only Stabilflo Valves will give you this remarkable performance



50 to 1 RANGEABILITY WITH UNIFORM CHARACTERISTICS

With this unique valve, you now can be sure that the extraordinary sensitivity, accuracy, and dependability of precision-engineered controllers are translated into matching valve performance.

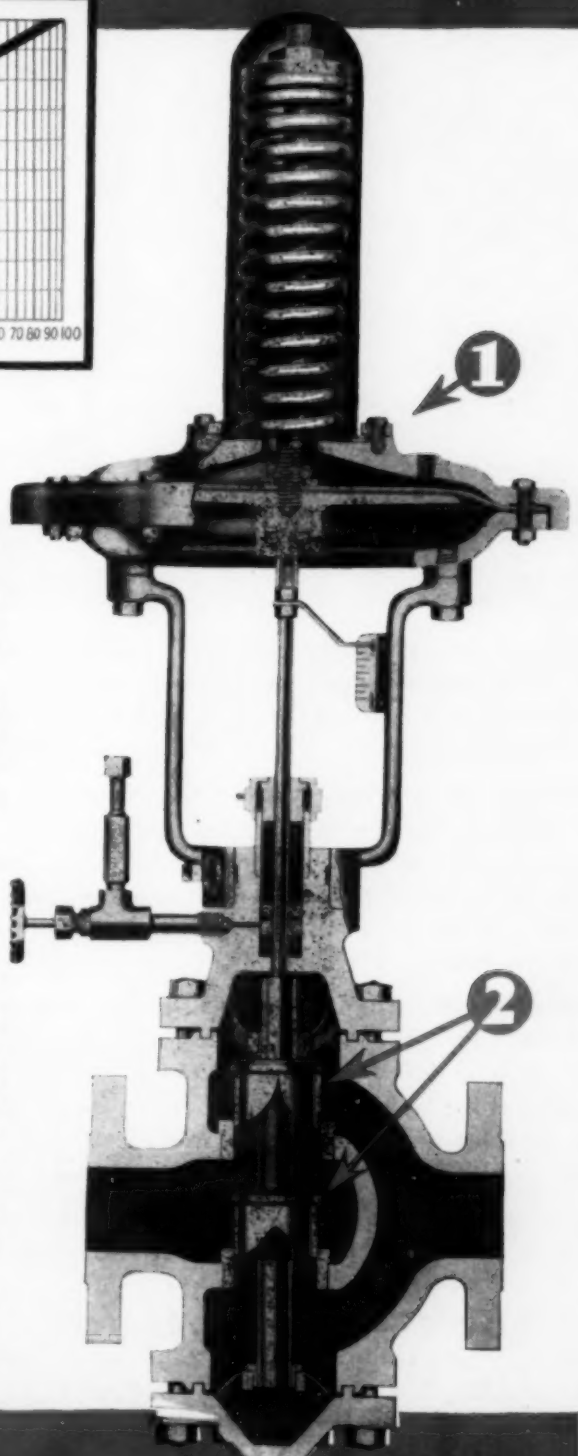
The unique characteristics of the Foxboro Stabilflo Control Valve are graphically revealed in the chart above; . . . *equal increments in controller output (and valve lift) produce equal percentage changes in flow.* Thus under constant pressure drop conditions and on a semi-logarithmic scale, the line plotted is straight.

This achievement was made possible by two major Foxboro developments in valve design. . . .

1 THE INVERTED TYPE MOTOR . . . By reversing the usual position of diaphragm and spring, Foxboro engineers practically eliminate all sources of friction in the action of the motor. Anti-friction bearings are unnecessary. The suspended construction of the valve motor requires no guides. A special flexible coupling between the valve stem and the diaphragm motor allows the stem to establish normal alignment.

This self-aligning motor with its floating action is an exclusive feature of Foxboro Stabilflo Valves.

2 WIDE RANGE V-PORT VALVES . . . This outstanding development corrects the common faults of control valves of conventional types. Almost any kind of port opening can produce equal percentage flow changes within a limited range, but Foxboro's WIDE RANGE V-PORT VALVE extends the limits to the full stroke of the motor. The greater the rangeability possessed by a valve, the greater its ability to handle unusual conditions. Hence, the 50 to 1 rangeability means that the Stabilflo Valve insures satisfactory control at all demands.



Since the success of any control system may depend as much on the performance of the valve as on the control instrument, it will pay you to investigate the advantages of Stabilflo Valves. Write for complete information. **The Foxboro Company, 16 Neponset Ave., Foxboro, Mass., U. S. A.** Branches in principal cities.

FOXBORO
REG. U. S. PAT. OFF.

AUTOMATIC CONTROL VALVES

port the beads in the tanks to prevent agglomeration.

Many large valves have been eliminated in the wet processing system by the use of a flexible rubber hose emptying into a four-compartment diversion box. By moving the hose to the appropriate compartment the effluent liquor may be sent to any of four other places in the system. In effect the diversion box acts as a valve with one inlet and a choice of four outlets. The device has been extremely valuable for the complex recycling of the various liquors through the multistage wet processing system. The diversion box is steel coated with Amercoat resin paint.

After wet processing, the beads are sluiced through lead piping and a waxed steel flume to the dryers.

DRYERS

In the dryers there is maintained an atmosphere of superheated steam which dries the beads at a temperature around 280 deg. F. Corrosion was the main problem in the operation of the dryers, particularly at the feed.

Some unusual phenomena, probably dew-point corrosion, were observed in some locations where stainless steel parts in contact with saturated steam vapors would corrode whereas ordinary steel nearby would not be affected. The reverse would occur in other localities. Internal drains, originally provided for removing the appreciable quantities of condensate resulting from the preheating of the beads to drying temperature by the circulated steam, plugged with mush and bead fines so that thin slurries of gel accumulated on subflooring, ran into fan housings and was picked up and sprayed on fan housings, heating coils and dryer walls causing severe corrosion and erosion.

After close observation of the bead preheating operation the problem was partially solved by the construction of steel pans under the first five feet of each conveyor provided with external drains and lined with a thin reinforced cement lining. The rest of the dryer surface was painted with the best paint combination found which was a double coat of red lead and one of high temperature aluminum paint. The dryers were so compactly constructed that replacement of corroded sections and protective painting is very troublesome because of inaccessibility of the affected parts. Some portions can be reached only by dismantling the dryer itself so that protective painting is impossible, and the operating life will be determined entirely by the corrosion rate. Should another dryer unit be built, or any of the present rebuilt, bronze will probably be used for all parts in the feed-end compartment.

After the beads leave the dryer they are hard and dry, ending corrosion problems.

CORROSION NEWS BRIEFS

At the annual meeting of The Electrochemical Society, Birmingham, the following were elected to fill the offices of the Corrosion Division: chairman, Dr. H. A. Pray, Battelle Memorial Institute, Columbus, Ohio; vice-chairman, Dr. H. J. McDonald, Illinois Institute of Technology, Chicago; secretary-chairman, Dr. I. A. Denison, National Bureau of Standards, Washington, D. C.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

MORE ABUNDANCE demands more comfort. The old "hot spots" in the plant which used to be endured as part of the job are now condemned. New plants are designed to have the form follow the function of air conditioning, but old plants have to fit the function to the form. Take for example an old sugar refinery, one whose steam plant daily delivers into process the steam produced from 350 tons of coal. It poses some knotty problems around the hot spots. But they are solvable.

Tanks and pipes can be insulated. Hot, wet-sugar scroll conveyors with their connections to the bottoms of the centrifugal curbs can be closed tight and the hot vapor sucked out. These vapors can then be passed, enroute to the fan, through a simple water spray condenser to improve capacity. The centrifugals are also covered, but it is not permitted to chill the sugar during purging as this increases the viscosity of the sirup which is to be removed. Between cycles the centrifugal baskets emit hot vapor that causes unhappiness, especially in the summer. Drawing all of the surplus heat out of the room by means of a vacuum is not practicable because this requires very large fans and it is difficult to direct currents of fresh air to the points where the workmen have to be. On the other hand, a current of fresh air can be forced through a nozzle into the area of the operator just as cold water is sprayed onto a fireman who has to get close to a fire. Besides, it is easier to push cold air than to pull hot air.

To save space (as well as cogitation!) the air supply is usually delivered through a header fitted with nozzles that blow downward from the ceiling. The current that reaches the operator is then a mixture of fresh air and the hot air near the ceiling, and it hits the workers in the neck. In August the temperature of the air two feet above the floor and eight feet above the floor were respectively 95 and 105 deg. F.

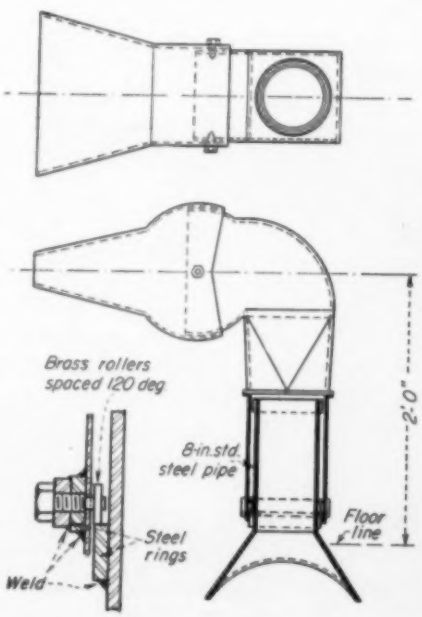
A PREFERABLE PRACTICE is to install a large header below the floor and project vertical branches up through the floor. These branches terminate in nozzles that rotate horizontally and swing vertically to deliver air according to the fancy of the individual operator. The illustration shows the swivelling nozzles, which the boys dubbed "duckbills."

A prankster painted some of the heads green and the bills yellow to imitate the prototype.* The Old Man did not object, knowing that if a little mirth can be injected into a hot dull task, a happier attitude is attained toward the job. The duckbills bring outdoor conditions into the room and the air movement creates well-being. The forced draft flows in streamlined manner towards the ceiling and finds its way out through the windows, floor openings, the roof monitor, or through induced draft fans that circumstances may require.

IN CONFORMITY with the practice of standardizing in the refinery there are only two sizes of fans in use: namely, No. 2½ and No. 4½. The number refers to the rotor diameter, each whole number corresponding to a unit of six inches. Thus a No. 2½ has a rotor diameter of 15 in. The fans are installed at the outside walls and draw fresh air from without. Suction pipes sometimes require to be extended toward the ground to avoid sucking in warm air which comes out of the windows.

For temporary repair jobs No. 2½ fans are made portable and provided with 3-hp. motors at 850 r.p.m. These are fitted with short steel suction pipes to reach a window and a steel or canvas discharge pipe to reach the hot spot. This keeps the boys on the job as it is less uncomfortable there than elsewhere. There is a good supply of portable fans in the storeroom for prompt shifting to any part of the plant.

The storeroom also contains a portable vertical fan with an extension cord to plug into a light socket. This is especially useful for sucking CO_2 gas out of box cars while dry ice is loading. The door sills are 4½ ft. above the floor and the heavy suffocating atmosphere below this level is thus removed. The fan rests on the floor, suction down, and discharges overboard through a 12-in. canvas hose. This device has halved the cost of loading cars.



"Duckbills" attached to header below floor direct cool air onto workers in hot spots. Nozzle design permits vertical and lateral adjustment

Centrifugals in the byproduct plant emit corrosive vapors. In this case we covered the curbs and provided a suction pipe from the curb to a fan which discharges through the roof.

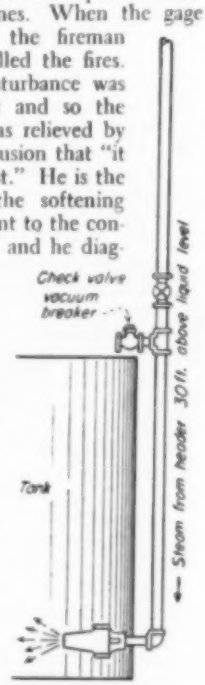
The fan is made of stainless steel and the pipes are compressed asbestos. After tank cars are boiled out and sterilized with steam they must be dried and cooled before loading of alcohol can begin. A No. 2½ fan is hung on the wall above the loading rack and is provided with piping to reach the dome of the car. The fan, having a capacity of 3,000 cu.ft. per min., ventilates and cools a tank car in a short time. A thoughtless operator a few years ago charged alcohol into a heated tank car. The fumes wafted toward an open window 50 ft. away where a sparking d.c. motor started a blast. A quarter of a carload of alcohol disappeared in blue flame and terrific heat. Sixty-five sprinkler heads released and some wire-glass windows were shattered, but by the grace of Providence no other damage resulted.

VICTORIA, of polandish birth, our little roly-poly charwoman with the smiling face and wrinkled forehead, came to America after World War I. During the late jobless era she refused the public dole and instead stuck fast to her job while supporting a lazy husband and putting her children through school. While she was preparing to apply for her citizenship papers a few years ago she tried to learn to write her name. We sat her down in the drafting room and told her to practice, but there was no use. The maximum of her mental and manual coordination was an X. When

* The chronicler had no part in the evolution of this idea but he furnished the paint.

radios grew low in price, she extracted great enjoyment as the little box was just like braile to a blind person. One night when she came in to brush up the drafting room, she was perturbed about the harangue of her spiritual advisor. She was bewildered by the doctrines; incidentally the monetary cost of the password to Saint Peter's gate was burdensome. She confided to the chronicler, "You are a man what knows many things. Tell me what is the best religion!" Discoursing on religious matters is not a specialty of engineers and we are not given to proselyting. We suggested that a pretty good common denominator with which nobody could have any dispute is the Golden Rule. Then we repeated the bewitching jingle about Abou Ben Adhem whose name God's Angel placed at the top of the plaque because of his outstanding love for his fellow men. Versatility is demanded of engineers in these times of distress!

WOOL SCOURING also has its little perplexities. The boilers of a nearby plant suddenly filled with bubbles and spewed water through the steam lines. When the gage glass registered zero, the fireman used his head and pulled the fires. The source of the disturbance was not at once apparent and so the strain on the mind was relieved by the conventional conclusion that "it musta been the chemist." He is the guy that prescribes the softening agents. An SOS was sent to the consulting "water doctor" and he diagnosed soap. Search in the plant disclosed a drop in the liquid level in a soap solution tank. The solution had syphoned through an injection heater by way of a branch steam line and then into a tubular heater on another branch which sent the soap with the condensate into the boiler feed tank. Somebody, in his wisdom, had shut off a valve in the steam header and the cooling had created a vacuum that sucked up the soap and induced the syphoning. This happens once every thirty years in every chemical plant. Then all of the injection heaters are examined and vacuum breakers provided in all the lines installed by the new generation of pipe fitters. "Innocuous desuetude" makes the check valve vacuum breaker plug. The most effective insurance against the risk is to install the steam supply header about 30 ft. above the tank so as to get beyond the capacity of vacuum to lift liquor. The sketch in the margin makes this clear.



A NEIGHBORING hair felt plant, built when the steam plant was considered a nuisance, is now equipped with mechanical stokers provided with forced draft fans. The temperature above the boilers in the low ceiling registered 125 deg. F. or more. To make the place endurable for the operator, the suction pipe of the forced draft fan was extended to the ceiling. The arrangement in-

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THE Stainless Steel Division of Pittsburgh Piping offers the largest selection of stainless steel welding fittings produced by any manufacturer. Welding fittings include 180° Return Bends, 45° and 90° Elbows, Reducers, Tees, Caps, and Lap Joint Nipples. I.P.S. sizes range from ½" to 10"; tube sizes from 1" to 24". Fittings are available in Stainless Types Nos. 304, 316, and 347. Other analyses can be furnished on orders for sufficient quantities.

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cidentally recovered some lost heat and returned it to the furnace. This device may be useful in many a steam plant.

OUR SENOR ALVARE, the master distiller, in order to obtain composure of spirit and possibly by way of expiation for his sins, occasionally joins the "Retreat of the Men of Malvern." The activities start Friday night and last till Monday morning and during this period the Men of Malvern disport themselves in sackcloth and ashes. On Monday morning they are discharged, contrite of heart, and with renewed dedication to the service of God and Man. During his sojourn in the lonely woods beyond the Township of Malvern, Senor Alvaré made the acquaintance of a certain Senor Calcos, of Spanish extraction.

A few nights later Senor Alvaré took his family to the cinema and at its conclusion at 10 p.m. he was about to enter his car when he witnessed a terrific collision. An inebriated gentleman and his feminine guest crashed broadside into a family car driven by a highschool boy, homeward bound from a party. Miraculously there were no bodily injuries but the boy's car was wrecked and the boy himself was in hysterics. Alvaré promptly called the police and his neighbor, the district attorney. The drunk was sent to the hoosegow (and eventually paid for the car). Alvaré, good Samaritan that he is, picked up the boy and delivered him to a hospital. After the boy's nerves had been composed, Al took him home, arriving there about midnight. And lo, the boy's father was none other than Senor Calcos, the Man of Malvern!

PVT. PETE, of the Imperial Army of Austria in World War I, crossed the Atlantic in 1922 and attached himself as porter in our office. In '23 the Immigration Department issued permission to import his wife and son. However, his wife procrastinated till '24. (She probably didn't have anything to wear!) By that time Washington had changed the rules and her permit was outlawed. The quota from Austria was filled and there was a long waiting list. The only recourse left to Pete was a seven-year wait to 1931 for his citizenship papers. The State Department then relaxed and Pete's wife and 20-yr. old son arrived in the fall. He had not seen them for nine years.

When Pete and his wife are at home alone, they converse in one of those numerous Teutonic dialects. The wife and her son talk in Slavic and Italian. When the grandchildren are present, the family language is English (or a modification thereof). The son's wife was born in America but her fireside language is an Italian dialect spoken in Abruzzi. She does not understand the Italian of her husband and mother-in-law. Pete talks German, Slavic and English, but no Italian. Each member of the family can talk with one other in a language not understood by the third.

Under the mopping up operations of Pete's crew of charwomen certain islands were isolated below the desks under the apology of poor visibility. After sunrise, these islands reflected unfavorably upon the boss. Pete applied a remedy for this. He removed the invisibility by sprinkling a smattering of sawdust into the dark spots.

NAMES IN THE NEWS

M. E. Spaght

F. W. Willard

G. L. Parkhurst

Monroe E. Spaght is leaving his position as manager of Shell Oil Co.'s manufacturing department in San Francisco to serve as vice president of Shell Development Co., research organization of Shell Oil, in New York. Dr. Spaght has recently returned to Shell after a wartime absence on technical missions to Germany and Japan.

Thomas F. Plummer is now production manager for international Plastic Corp., Morristown, N. J. He was formerly plant manager of the H. B. Catty Corp., Norwalk, Conn.

Linus C. Pauling, of the California Institute of Technology, has been announced to be the 1946 Willard Gibbs medallist. Presentation of the medal will be made to Dr. Pauling June 14.

W. C. Kabrich has joined the Flintkote Co. as assistant director of research and is stationed at the East Rutherford Laboratory of the company. Recently retired from the United States Army after nearly 30 years of service, Brigadier-General Kabrich has long been actively associated with chemical engineering, research and development.

William W. Pigman has been appointed to the organic chemistry group of the Institute of Paper Chemistry. For the last two years Dr. Pigman was a group leader in the research department of the Corn Products Refining Co.

Norman A. Matthews, formerly a lieutenant colonel in the U. S. Ordnance Department at the Watertown Arsenal, has been appointed works metallurgist of Electro-Alloys Division of the American Brake Shoe Co.

Robert M. Hubbard is now associate professor in chemical engineering at the University of Virginia, Charlottesville. Dr. Hubbard is a graduate of the University of Michigan and has had a number of years experience in chemical engineering development and plant design.

Frederic W. Willard, president and a director of the Nassau Smelting and Refining Co., a subsidiary of Western Electric Co., and a chemical engineer and metallurgist of national prominence, has retired after 40 years of service with the Bell System.

Martin D. Whitaker, director of the Clinton Laboratories operated by Monsanto Chemical Co. in Oak Ridge, Tenn. has been named president of Lehigh University and begins his new duties June 1.

Ellery H. Harvey, of Sun Chemical Corp., New York, has been elected president of the Institute of Food Technologists.

Rodolfo Mebus, professor of chemistry at the University of Santiago and director of the department of industrial development for the Chilean government, was one of the group of Latin American educators who recently inspected several of our engineering colleges.

George L. Parkhurst succeeds **R. G. Smith** as president of Oronite Chemical Co., San Francisco, subsidiary of Standard of California. Mr. Parkhurst was formerly vice president in charge of products and processes and during the war served with the Petroleum Administration for War. Mr. Smith will continue with Oronite as a member of the board of directors.

Walter K. Farst, who has been chief engineer in chemical plants operated by the chemical and cement division of the Pittsburgh Plate Glass Co., has been named general manager of the cement plant located at Zanesville, Ohio. He succeeds the late **Arthur R. Haley**.

Bruce M. Bare, Jr., has rejoined Sharples Chemicals, Inc., after military service in the CWS. He has been named district manager in the Sharples Chicago office. He succeeds **Malvern J. Hiler** who is now associated with the Stepan Chemical Co., Chicago. Mr.

Prof. Mebus in conversation with Prof. Marston T. Bogert, president of the International Union of Pure and Applied Science

Hiler joined the Stepan Co. early this month as director of research and chemical development.

Chester S. Allen has been elected president of Lockwood Greene Engineers succeeding the late **Albert L. Scott** who died March 2.

Douglas C. Reybold has rejoined the Dorr Co., New York. Lt.-Col. Reybold had been on military leave from the company since July 1942.

Howard R. Gaetz has been appointed plant superintendent of the synthetic rubber plant operated by the U. S. Rubber Co. at Naugatuck, Conn.

Benjamin O'Shea has retired as chairman of the board of directors of the Union Carbide and Carbon Corp. The office has been abolished. Mr. O'Shea will remain a director and member of the executive committee.

J. Mitchel Fain, until recently a colonel with the Chemical Warfare Service, has rejoined the staff of Foster D. Snell, Inc., Brooklyn, as account executive in charge of technical development for a group of manufacturers of chemical specialties.

William I. Burt has been appointed vice president-manufacturing for the B. F. Goodrich Chemical Co., and **Frank K. Schoenfeld** has been named vice president-technical. Mr. Burt was formerly general manager of plants, and Dr. Schoenfeld has been technical director for the chemical company. Both have been with Goodrich since 1927.

Henry C. Sherman has been named one of the 1946 recipients of the Franklin Medal. Dr. Sherman received the medal last month "in consideration of his many contributions to the science of nutrition." The other recipient was **Henry T. Tizard,** president of Magdalen College.

W. I. Lourie, Jr., has succeeded **Henry O. Parsons** in the chemical unit of the Bureau of Census. Mr. Parsons left Census in March to take a market research position with the Bonneville Authority in Portland, Ore.

David R. Schwarz has returned to the staff of Schwarz Laboratories, Inc., New York, after serving 27 months in the Naval Reserve. He has resumed responsibility for chemical manufacturing and technical development operations and will devote part of his time to chemical engineering consulting.

F. Dudley Chittenden and **George R. Vila,** chemical engineers, have been appointed assistant development managers of the Naugatuck Chemical division, U. S. Rubber Co., at Naugatuck, Conn.

Floyd D. Dean has been appointed works manager of the new Washington, W. Va., plastics plant of E. I. du Pont de Nemours & Co. Construction on this new 400-acre unit is scheduled to begin this spring.

Wilbur A. Lazier is the 1946 recipient of the Herty Medal, which will be awarded by the Georgia Section of the American

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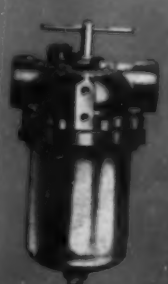

AUTO-KLEAN *disc-type.* For all fluids except those containing highly abrasive solids. Viscosities from 30 to 50,000 Saybolt seconds. Minimum pressure drop. Continuously cleanable by turning a handle (manually or automatically). Occupies no more space than usual partial-flow type. Sizes from 1¼" diam. x ⅞" cartridges to massive motor-driven models. Available with or without sump for built-in or external installations.

FLO-KLEAN *wire-wound.* For fluids containing highly abrasive solids such as metal chips, abrasive wheel particles, sand, etc. May be designed to remove particles .0025" or larger. Continuously cleaned by backwash system. Low pressure drop — fluid moves in straight line, encountering only momentary restriction. All parts made of metal — construction to meet varying corrosive and erosive conditions.

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- ☐ Cellulose
- ☐ Cement
- ☐ Chocolate
- ☐ Coatings
- ☐ Coolants
- ☐ Dope
- ☐ Enamels
- ☐ Extracts
- ☐ Flavors
- ☐ Fuel Oil
- ☐ Gases
- ☐ Gasoline
- ☐ Glue
- ☐ Grease
- ☐ Gum
- ☐ Hydrogenated Oil
- ☐ Ink
- ☐ Lacquers
- ☐ Latex
- ☐ Molasses
- ☐ Paint
- ☐ Palm Oil
- ☐ Paraffine
- ☐ Paste
- ☐ Pyroxylin
- ☐ Resins
- ☐ Rubber Cements
- ☐ Sizing
- ☐ Soap
- ☐ Solvents
- ☐ Syrups
- ☐ Tar
- ☐ Tooth Paste
- ☐ Vegetable Oils
- ☐ Water
- ☐ Wax

Others .....

Name .....

Company .....

Address .....

Title .....

Chemical Society on May 4 at Milledgeville, Ga. Dr. Lazier is director of Southern Research Institute.

Stuart O. Fiedler has been appointed manager of the South Chicago Branch of Bjorksten Laboratories. Mr. Fiedler, a chemical engineering graduate from the University of Wisconsin, was previously connected with the Burgess Laboratories and E. I. du Pont de Nemours & Co.

Alton E. Bailey, an authority on the processing of edible fats and oils, has joined the Votator division of the Girdler Corp, Louisville, Ky., where he will head a research and engineering group specializing in the development and improvement of processes and products.

Jack A. Gerster is now assistant professor of chemical engineering at the University of Delaware. Dr. Gerster was previously connected with the Du Pont company and spent a large part of 1944 and 1945 on the Manhattan Project.

H. Douglas Tate and **Travis W. Brasfield** have joined the staff of the U. S. Rubber Co.'s agricultural experiment station at Bethany, Conn. Both will engage in research for new agricultural chemicals and also will continue laboratory and field testing of chemicals produced by the Naugatuck Chemical Division.

Paul Burchfield, formerly assistant supervisor of the chemical engineering section of Wyandotte Chemicals Corp.'s research department, has been transferred to the technical service department as assistant director.

Lawrence A. Monroe, recently returned from Germany as a TIIC investigator, has joined the Ethyl Corp. in New York as chemical engineer. During the war Dr. Monroe had charge of chemical research for OPRD in the War Production Board.

Mathilde Ramsey, microanalyst, and **Sue S. Sanders**, microbiologist, have joined the staff of Southern Research Institute, Birmingham, Ala.

Courtland F. Carrier, former head of the chemical section of the engineering department of Anaconda Wire and Cable Co., Hastings-on-Hudson, New York, is now associated with the Centro Research Laboratories, Inc., Briarcliff Manor, New York, as special assistant to the director.

Robert L. Massengale has joined the Dicalite Co. in the capacity of engineer in their paper products division. At present his headquarters will be in the Chicago office of the company.

Paul G. Marsh has been appointed assistant production manager of the organic chemicals division of Monsanto Chemical Co. and **A. J. Pastene** has succeeded him as manager of the company's John F. Queeny plant in St. Louis.

P. C. Wilbur, Food Machinery Corp., San Jose, Calif., has recently been elected vice-president of the company. Formerly director of research, Mr. Wilbur will now be

Why you can be sure of higher CORROSION-RESISTANCE, positive NON-ABSORPTION *with* LAPP CHEMICAL PORCELAIN

1 LAPP *SPECIFIED* CLAYS ARE *NOT* FOUND IN "BACK DOOR" CLAY PITS...

LAPP has gone as far as necessary—even to England—to obtain carefully selected clays that meet rigid LAPP specifications for plasticity, impurity content, acidity and other important properties. And every carload is scientifically inspected at the plant before the clay goes into production.

2 THE SECRET OF *EXTRA* STRENGTH, *GENUINE* NON-POROSITY, IS THE LAPP VACUUM PROCESS . . .

LAPP Chemical Porcelain is made from liquid clay slip which passes through this vacuum chamber. Here all air, in bubbles and in solution, is boiled out. Subsequent operations are performed without incurring voids, laminations or blebs.

3 *THOROUGHLY* VITRIFIED BODY PRODUCED IN THE LAPP *CONTINUOUS* KILN . . .

In LAPP'S 380-foot tunnel kiln temperatures exceeding 2250°F are scientifically controlled. The formed clay is slowly brought to the exact molten stage where *complete* vitrification occurs, fusing the clay body into *solid* Porcelain, chemically inert and well beyond the degree of vitrification found in ordinary ceramics.

You get all the "natural" advantages of ceramics *developed to their highest degree* when you install LAPP Chemical Porcelain. Complete corrosion-resistance to all acids (except HF), positive non-absorption, added mechanical strength are plus advantages of LAPP Chemical Porcelain. These are made possible by its *extra* dense, homogeneous, *thoroughly* vitrified body.

If you've had trouble with ceramics on a problem that ceramics should solve—it will pay you to experience the difference in LAPP Chemical Porcelain. *LAPP Insulator Co., Inc., Process Equipment Division, LeRoy, N. Y.*

LABORATORY QUALITY IN PLANT PRODUCTION WITH

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Process Equipment Division

VALVES • PIPE AND FITTINGS • RASCHIG RINGS • TOWERS • KETTLES • FILTERS • SPECIAL SHAPES

responsible for coordinating the research work of the various company divisions for the purpose of developing new products and processes. **J. B. Cary, J. M. Hait** and **B. C. Carter** were also elected vice presidents.

Donald P. Krotz is now assistant to the president of California Research Corp., a subsidiary of Standard Oil Co. of California, San Francisco. Following graduation from Stanford, Mr. Krotz joined the company at the Richmond refinery, where after 12 years in engineering, maintenance, and distillation operations, he was transferred to Standard's department on organization in San Francisco.

Daniel B. Curll, Jr., has joined Commercial Solvents Corp. in New York as assistant to the vice president in charge of sales. Since 1939 Mr. Curll has been assistant to the president and general manager of the chemical division of the Rumford Chemical Works and for the last five years has been a director.

Stanley J. Hultman, formerly superintendent of the Southern Alkali plant at Corpus Christi, Tex., has been appointed plant superintendent of the government-owned Lake Charles plant which has been leased by Southern Alkali Corp. to produce caustic and chlorine.

Joe B. Holmes is now a group leader of the chemical engineering division of the General Electric Chemical Department, Pittsfield, Mass. Mr. Holmes is in charge of all chemical engineering operations which include design and operation of pilot plants as well as full scale plants on new processes. He is a chemical engineering graduate from Nevada University.

William C. Decker, vice president of Corning Glass Works has been elected president, succeeding **Glen W. Cole** who is now vice chairman of the board of directors. **John L. Ward**, formerly treasurer, has been made manager of the Bulb and Tubing Division and **Jesse T. Littleton**, vice president and associate director of research has been designated director of research.

Joseph E. Bludworth has been appointed director of petroleum chemicals research and development of the Celanese Corp. of America. He will be concerned with the starting-up operations of the corporation's chemical plant at Bishop, Tex.

Dinwiddie C. Reams, Jr., has been appointed part-time instructor in chemical engineering at the University of Virginia, Charlottesville.

J. Kenneth Craver, of the Monsanto Chemical Co.'s research staff at St. Louis, Mo., has been appointed coordinator of plasticizers and resins for the organic chemicals division of the company.

Earl C. Petrie, who joined the research department of North American Refractories Co. in 1940, has been appointed assistant director of research.

L. M. Crockett, formerly superintendent of construction and maintenance, who has been

with the Upjohn Co. since 1911, has been named vice president and director of engineering.

Eugene P. Wigner has been appointed director of research and development for Monsanto Chemical Co.'s Clinton Laboratories at Oak Ridge, Tenn. Dr. Wigner will be on leave of absence from the faculty of Princeton University.

Kenneth D. Bowen, formerly plant manager of the styrene plant of Dow Chemical Co. at Velasco, Tex., has been appointed plant manager of the chemical plant of Celanese Corp. of America at Bishop, Tex.

C. T. Spivey, who has previously served in numerous capacities in industrial relations work for the Columbia Steel Co. of San Francisco, is now assistant director of industrial relations for the company. Mr. Spivey is a graduate of Stanford University.

Howard F. Kley, former research department engineer for Shell Oil Co. at the company's Martinez, Calif., refinery, has been advanced to senior engineer. His headquarters will be in San Francisco.

Martin S. Peterson, formerly editor of publications at the Nebraska Experiment Station at Lincoln and editorial expert with the QM Subsistence Development and Research Laboratory, Chicago, during the war, has been appointed technical editor of the Western Regional Research Laboratory, Albany, Calif.

Roy A. Lind has been advanced to assistant chief engineer at Shell Oil Co.'s Wilmington, Calif., refinery, where he was formerly senior engineer.

M. F. Astle, formerly chemist-in-charge at Martinez, Calif., for Shell Chemical Corp., has been made senior technologist in Shell's head office in San Francisco.

OBITUARIES

Henry O. Forrest, 48, assistant vice president of the M. W. Kellogg Co., died in Teaneck, N. J., April 15.

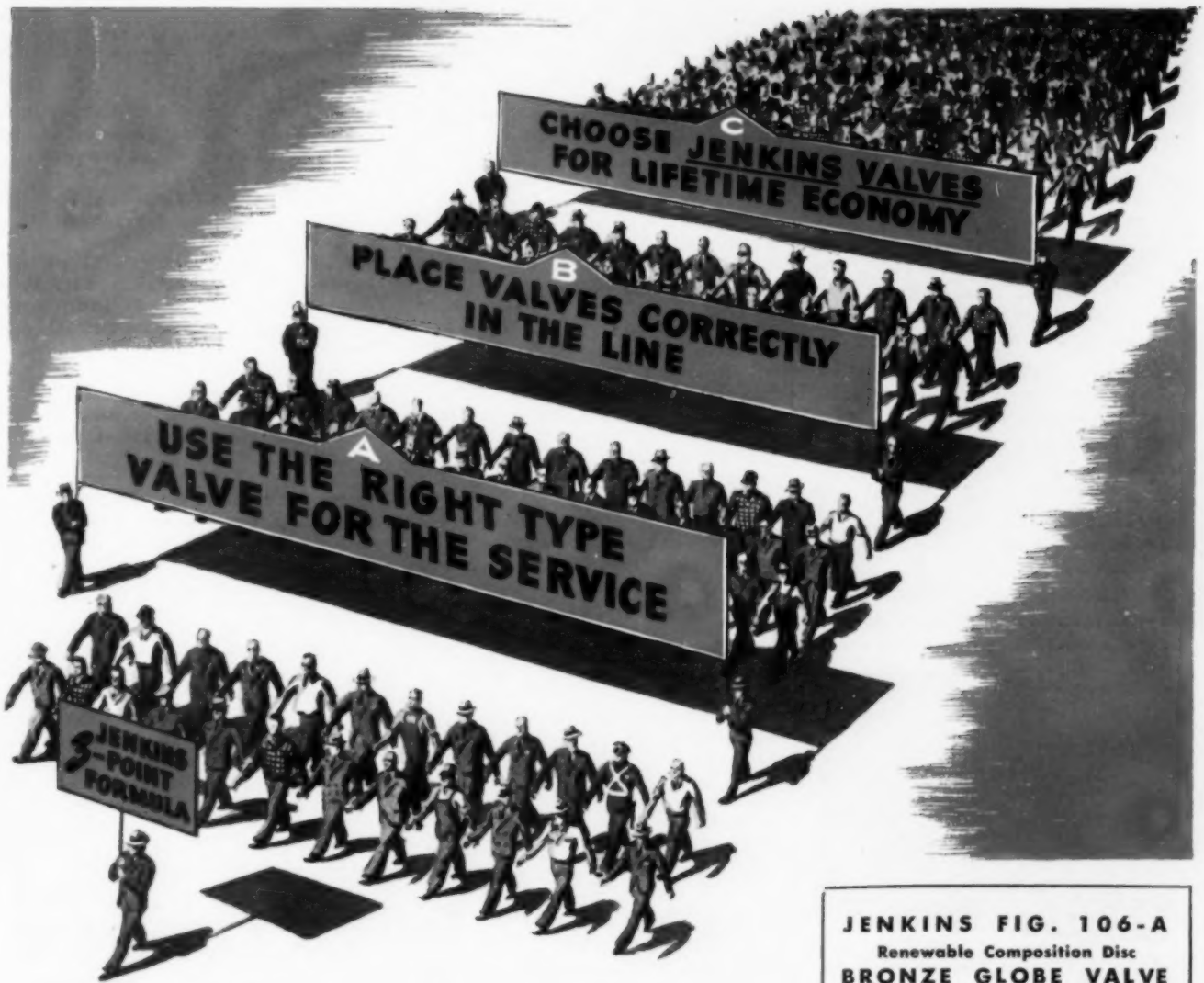
Albert C. Hunter, 53, chief of the Division of Microbiology, Food and Drug Administration, Federal Security Agency, died at his home in Maryland April 13.

Ferd H. Dieckmann, 44, secretary-treasurer of Sannette, Inc., pharmaceutical manufacturers, died in Cincinnati April 22.

Adolph G. Rosengarten, 76, former president of Rosengarten & Sons and a director of Merck & Co., died in Philadelphia April 22.

William H. Easton, 65, vice president of Sheldon, Morse, Hutchins & Easton, public relations counsel, and of the Safety Research Institute, died at his home in Bayside, N. Y., April 27.

Major E. Holmes, 64, dean of the State College of Ceramics at Alfred University and founder of the Ceramic Association of New York, died in Hornell, May 2.



Join the parade of valve-wise buyers

More and more valve users are adopting the Jenkins 3-Point Formula as a valve buying guide – for good reasons.

By careful selection of pattern and metal, they get the valve types *best* suited to withstand service conditions and require least maintenance.

By installing valves correctly – in the right location, with proper care – they extend valve service life, lower valve cost-per-year. Jenkins Booklet No. 944 is an excellent guide to correct installation. Write for a copy.

By choosing Jenkins Valves, they get valves made with *extra* endurance that means *extra* economy. They also get the experienced advice of top-rated valve specialists, Jenkins Engineers, whenever they need it, on any question of selection or placement.

Base *your* valve buying on the 3-Point Formula, and make sure of the *extra* value that means *lowest cost in the long run.*

LOOK FOR THIS JENKINS DIAMOND MARK

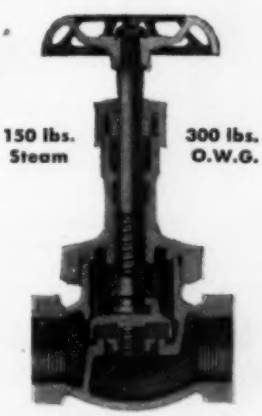
SINCE Jenkins Bros. 1864

JENKINS VALVES

For every Industrial, Engineering, Marine, Plumbing-Heating Service . . . In Bronze, Iron, Cast Steel and Corrosion-resisting Alloys . . . 125 to 600 lbs. pressure.

Sold Through Reliable Industrial Distributors Everywhere

JENKINS FIG. 106-A
Renewable Composition Disc
BRONZE GLOBE VALVE



A renewal composition disc valve. Fig. 106-A features a convenient slip-on stay-on disc holder that permits a quick change of disc. The resilient Jenkins composition disc assures drop tight closure with least closing effort. The bevel joint between the body and bonnet serves as an internal brace and resists the crushing effect of the body assembly.

ONE OF OVER 600 EXTRA VALUE VALVES MADE BY JENKINS *VALVE SPECIALISTS*

INDUSTRIAL NOTES

Mathieson Alkali Works, Inc., New York, plans to build a new pilot plant at Niagara Falls, N. Y.

Pacific Mfg. Corp., Cleveland, recently organized to manufacture and merchandise self-contained room air conditioning units, has named Stephen C. May vice president and general sales manager.

Milton Roy Pumps, Philadelphia, made a change in organization on April 1. All assets, liabilities and good will of the partnership of Milton Roy have been transferred to Milton Roy Co., a Pennsylvania corporation. There is no change in personnel, management, or policies in the new organization.

Pennsylvania Salt Mfg. Co. of Washington, Tacoma, western subsidiary of the Pennsalt Co. has named T. E. Moffitt sales manager. He will be in charge of heavy chemical sales activities in the Tacoma, Wash., and Portland, Ore., plants. His headquarters will be at Tacoma.

Ilg Electric Ventilating Co., Chicago, Ill., has appointed E. J. Stone manager of the Detroit office. Capt. W. L. Hochschild joins the company as sales engineer in the Chicago Office. John D. Briggs has been assigned to the branch office in Philadelphia. William S. Gorham has been appointed sales engineer in Los Angeles.

Ethyl Corp., New York, has appointed Stuart Forbes assistant manager of the Philadelphia division of the company.

Swenson Evaporator Co., New York, has moved its office from 136 Liberty St. to 30 Church St.

Henry Bower Chemical Mfg. Co., Philadelphia, has added John J. Berilla to the company's chemical staff as assistant chief chemist.

Gasflux Co., Mansfield, Ohio, has appointed Douglas C. Ogilvie eastern division manager with headquarters at 487 Orange St., Newark, N. J.

International Nickel Co., Inc., New York, has enlarged the Chicago technical section, with the addition of Homer W. Northup to its staff. He will be associated with foundry activities in that territory.

Hercules Powder Co., Wilmington, has promoted Thomas G. Batchelor to the position of assistant director of sales of the paper makers chemical department. E. Hoke Martin, will succeed him as resident manager of the Freeman plant. Henry Reeves, Jr., becomes departmental sales representative at Kalamazoo, Mich. Henry L. Mellen has been appointed assistant manager at Holyoke, Mass. Thomas L. Stirling will join the sales staff at Holyoke. L. E. McKenzie

LET EFFECTIVE LUBRICATION HELP ADVANCE YOUR SHIPPING DATES

EFFECTIVE *Texaco* lubrication keeps machines operating efficiently, reduces downtime for servicing and maintenance. Your production goes up accordingly. In addition, Texaco Lubricants and Lubrication Engineering Service help you improve quality, cut rejects and lower costs.

There are service-tested Texaco Lubricants to keep every machine in your plant running smoothly . . . and Texaco's Lubrication Engineering Service—available to Texaco users—will see to it that you use the *right* lubricant, in the *right* amount, in the *right* place.

Also important to you—Texaco's nationwide facilities enable you to centralize purchases for all your plants and get local delivery service right to your receiving platforms. For effective, cost-saving lubrication and service, Texaco is definitely preferred in many fields.

Find out what Texaco can do for *you!* Call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write

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The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Lubricants, Fuels and Lubrication Engineering Service

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT STARRING JAMES MELTON WITH HIS GUEST, ED WYNN—CBS

has been transferred to the industrial chemical division in New York.

S. P. Kinney Engineers, Inc., Pittsburgh, has appointed Watson & Watson, Knoxville, Tenn., to handle sales in eastern Tennessee.

Kellogg Chemical Co., Detroit, has doubled its space as part of an expansion program. The company offices are located at 5680 Twelfth St.

Hall Laboratories, Pittsburgh has transferred F. A. Sarcone to the company's technical service staff in St. Louis. He will work in the St. Louis, Kansas, Nebraska, and Oklahoma areas.

Timken Roller Bearing Co., Canton, Ohio, has promoted Walter F. Green to assistant manager of the division of research and development. Joseph F. Roshong has been named superintendent of the division and Harley J. Urbach works engineer.

Eastern Gas & Fuel Associates, Koppers coal division, Pittsburgh, has made a further expansion in the technical service organization. Charles H. Sawyer has been appointed research engineer. Paul J. Stein has been appointed industrial service engineer.

Harris Calorific Sales Co., St. Louis, has named Richard G. Taylor to the post of general manager. The company's manufacturing headquarters are located in Cleveland, Ohio.

Eaton Mfg. Co., Cleveland, Ohio, has acquired all outstanding shares of Dynamatic Corp., Kenosha, Wis.

Gotham Instrument Co., New York, has placed Jack Rudin in charge of the company's pressure gage department.

Westinghouse Electric Corp., Pittsburgh, has named W. D. Ligon as works manager of the new Buffalo plant into which the corporation's motor division is moving from East Pittsburgh. Franklin L. Snyder has been named engineering manager of the Sharon transformer division.

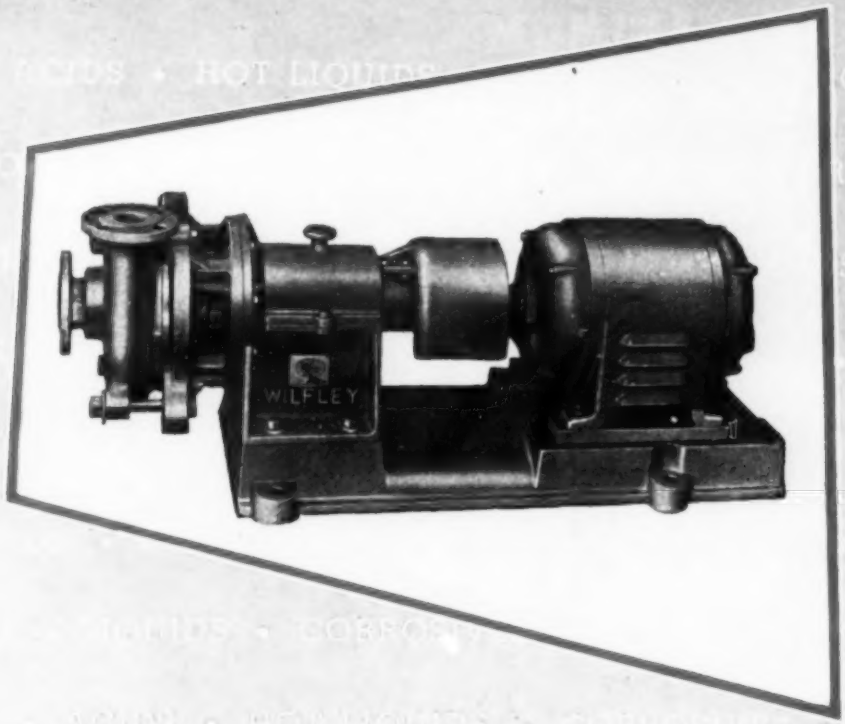
Rockwell Mfg. Co., Pittsburgh, has pooled the engineering and research staffs of the Nordstrom Valve Co. and Edward Valves, Inc., to give impetus to their product development program.

Quaker Oats Co., Chicago, has made Frank F. McKinney supervisor of technical sales of the recently formed chemicals department.

Alloy Steel Products Co., Linden, N. J. has placed Daniel J. Killfoile on the company's sales staff.

Allen-Bradley Co., Milwaukee, Wis., has moved its Boston office to larger quarters at 55 Oliver Street.

Cabot Carbon Co., retort chemical division, Boston, a subsidiary of Godfrey L. Cabot, Inc., has signed contracts and construction is underway at Gainesville, Fla., on expan-



for ACIDS

WILFLEY is the dependable pump that takes the trouble out of handling acids, corrosives, hot liquids, mild abrasives. Exclusive features of design and construction, plus individual engineering on every application enable this pump to deliver uninterrupted 24-hour-a-day production in both intermittent and continuous operations. 10- to 2,000-G.P.M. capacities; 15- to 150-foot heads and higher. It's the pump to buy when you want low costs... Write or wire for further details.

WILFLEY
centrifugal PUMPS

A. R. WILFLEY & SONS, INC., Denver, Colorado, U.S.A. New York Office: 1775 Broadway, New York City

sion of facilities for distilling pine tars and oils. The expansion will increase output by about 50 percent.

Pemco Corp., Baltimore, has added J. Eugene Eagle to its sales staff. For the last three years he was chief of the nonmetal section, War Production Board.

Whiting Corp., Harvey, Ill., has named C. C. Hermann special representative for the sale of its line of dust collector and spark suppressor equipment in Indiana, Michigan, Ohio, western New York and western Pennsylvania. His headquarters are at 1342 Harvard Road, Grosse Pointe Park, Mich.

Atlantic Plastics, Inc., Flushing, N. Y., has announced that the Reading division will operate under the name of The Polymer Corp. No change in policies or operating personnel will be effected. The new company will be an affiliate organization instead of a division of the parent company.

David Gordon & Co., Inc., New York, was formed in April. Samuel G. Adams is chairman of the board, and Albert de Chiara is president. The activities of the company are under the direct supervision of the executive vice president, David Gordon.

Colorado Fuel & Iron Corp., Wickwire Spencer steel division, New York, has transferred D. A. Sutch to the Clinton plant where he will be general superintendent.

Ceco Steel Products Corp., Chicago, has made Ralph K. Alexander the firm's Texas manager with headquarters in Houston. Ceco recently purchased eight acres of land in Houston and plans to erect a new plant. It will be located on the MKT railroad.

American Chain & Cable Co., Inc., Helicoid gage division, Bridgeport, Conn., has appointed R. H. Brown & Co., Portland, Ore., as its representative in the Portland area.

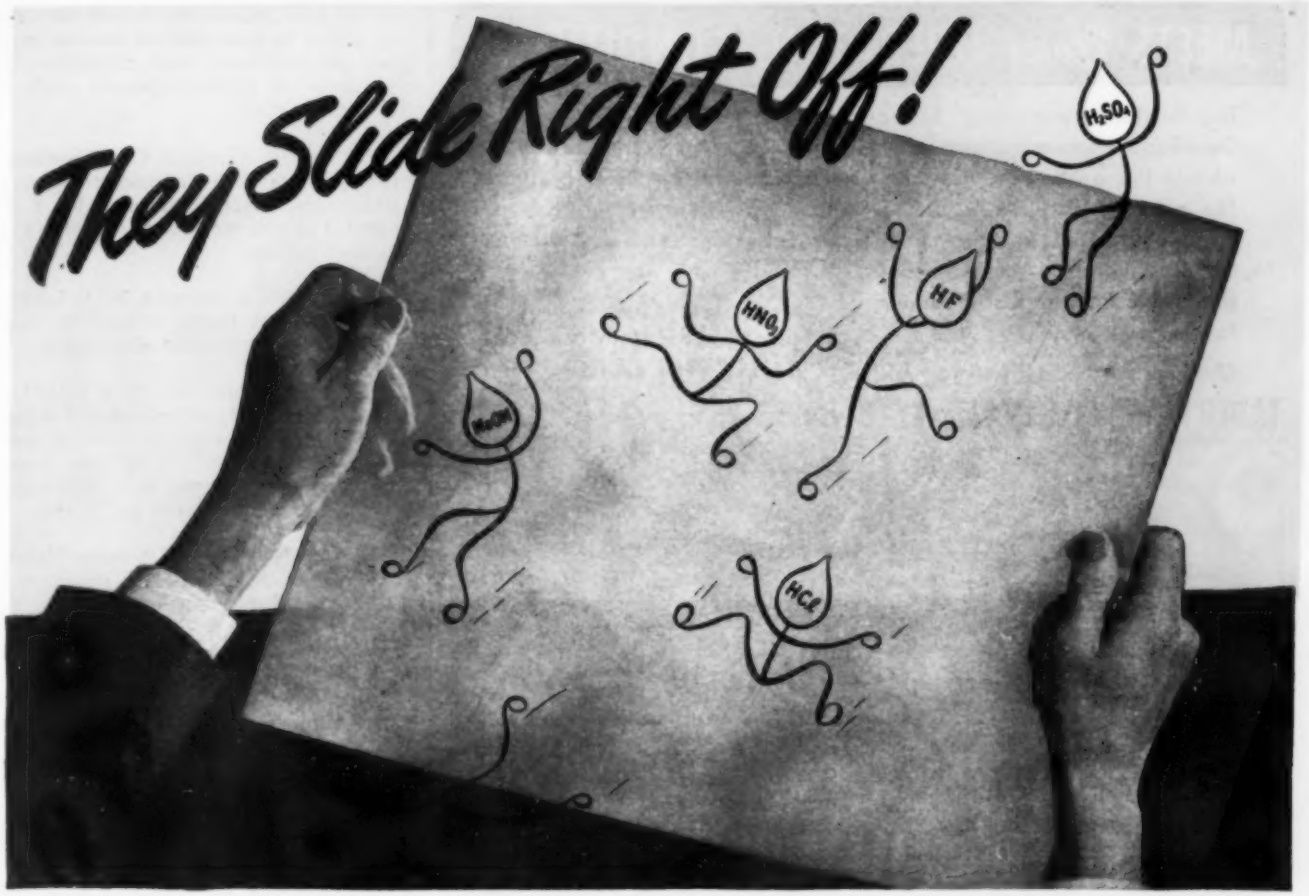
Raybestos-Manhattan, Inc., Manhattan rubber division, Passaic, N. J., has appointed the Republic Supply Co. of California as distributor of its industrial rubber products. Republic will serve the petroleum industry throughout California and the general industrial trade in southern California.

Pressed Steel Tank Co., Milwaukee, has established a new district office in Cleveland. The new district includes Ohio, most of West Virginia, the western portion of Ontario, New York, Pennsylvania, Maryland and Virginia; and the eastern portion of Michigan, Kentucky and Tennessee.

Patterson Foundry & Machine Co., East Liverpool, Ohio, has returned Col. Harry J. Karakas to the New York office staff. He recently returned after five years in the army.

Rust Engineering Co., Pittsburgh, Pa., has placed J. Paul Scheetz on the company's executive staff.

National Radiator Co., Johnstown, Pa., has purchased the Pullman-Standard Car Co.'s



CORROSIVE CHEMICALS GET NO GRIP ON

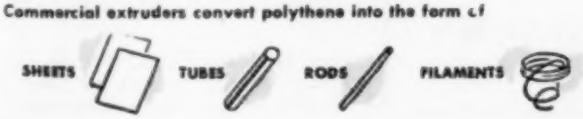
DU PONT POLYTHENE

For containers of all kinds, gaskets, cap liners, and tubing . . . the outstanding chemical inertness of Du Pont polythene is one of its chief advantages. Men who handle corrosive chemicals are constantly finding new uses for this versatile Du Pont plastic. But chemical inertness is not the whole story . . . far from it.

Polythene absorbs practically no water (0.005%). It is light in weight (specific gravity 0.92). Extremely tough and flexible at low temperatures. Tasteless . . . odorless . . . non-toxic, it contains no plasticizer. Can be injection- or compression-molded, extruded, calendered or heat sealed. Sure you have complete data on this unique thermoplastic? If not, write E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Room 105, Arlington, N. J.

AT ROOM TEMPERATURES THERE IS NO KNOWN SOLVENT FOR DU PONT POLYTHENE

Du Pont manufactures polythene molding powder.
Commercial extruders convert polythene into the form of



DU PONT
REG. U. S. PAT. OFF.
Plastics
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

plant at Middletown, Pa. It will fabricate steel boilers for industrial and domestic purposes, pressure vessels, heat exchangers and other industrial products formerly made at the Lebanon plant.

B. F. Goodrich Chemical Co., Cleveland, has made Sam L. Brous manager of sales development, James C. Richards has been promoted to sales manager of synthetic and reclaimed rubber.

Bogue Electric Co., Paterson, N. J., has appointed Robert S. Herwig to head the company's plating equipment department.

United States Rubber Co., New York, has named Clarence H. Sigler technical representative for the Naugatuck chemical division of the company. He will also represent Dispersions Process, Inc. Mr. Sigler will make his headquarters in Detroit.

Elastic Stop Nut Corp. of America, Union, N. J., has elected Charles E. Heintz vice president in charge of sales.

American Machine and Metals, Inc., East Moline, Ill., has appointed George P. Hebard district sales manager of its Pacific Coast territory with headquarters in San Francisco.

Taylor Instrument Cos., Rochester, N. Y., has made N. B. Nichols director of its research division.

Ohio Stainless & Commercial Co., Cleveland, has established a warehouse at East 55th St., Cleveland. Robert N. Harwood has joined the company as general manager.

A. J. Smith Corp., Kansas City, Mo., has purchased the controlling interest in Black, Sivalls & Bryson Inc. The sale covered both the Kansas City and Oklahoma City plants, six wood tank plants, and a network of branch plants, warehouses, sales offices, and field service offices in the United States and Canada.

General Aniline & Film Corp., New York, has elected David B. Dyche to the position of vice president. He will continue to serve as treasurer.

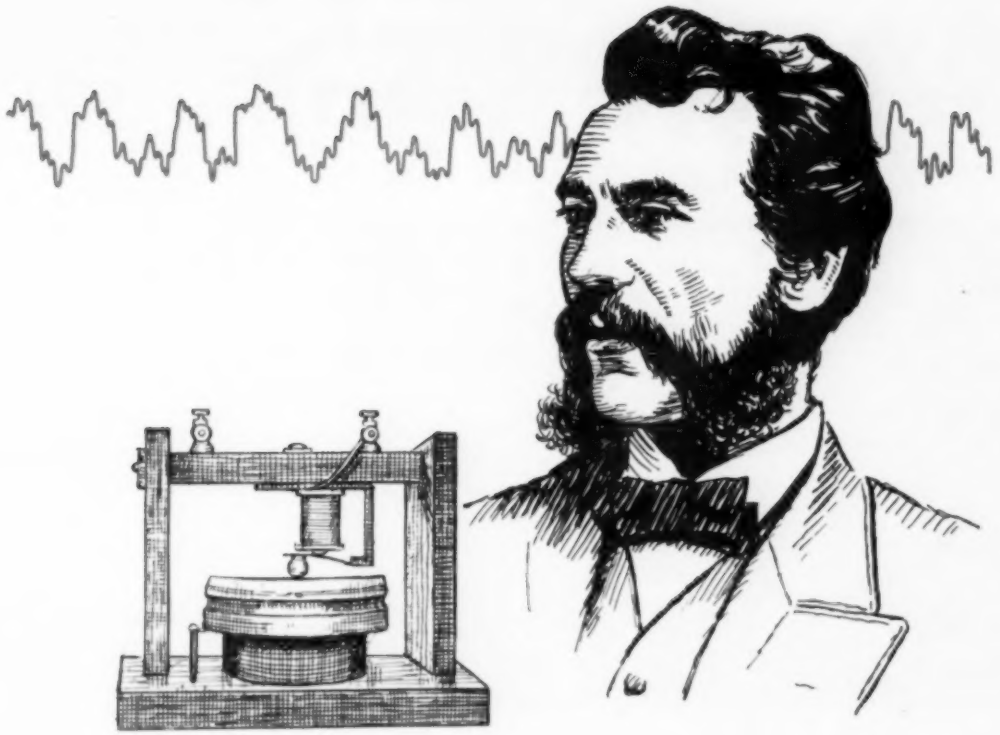
Speedways Conveyors, Inc., Buffalo, has moved the company's main office, including the sales engineering, and accounting departments, to the plant location at 1261 Niagara St.

Portland Gas & Coke Co., Portland, Ore., has announced the appointment of William G. Hirschfeld as products sales engineer. Mr. Hirschfeld was formerly with the Reilly Tar & Chemical Corp., New York.

E. & F. King & Co., Boston, Mass., has appointed J. H. Remick, Jr., vice president.

Nordberg Mfg. Co., Milwaukee, Wis., has elected F. H. Kilberry to the position of executive vice president and director.

Food Machinery Corp., San Jose, Calif., has announced the election to the board of directors and executive committee of Ben



"If I Could Make..."

Alexander Graham Bell once stated the principle: *"If I could make a current of electricity vary in intensity precisely as the air varies in density during the production of sound, I should be able to transmit speech telegraphically."* When Bell had *proved* this, the telephone was born.

Proving that principles are practical is still the method of science in achieving ever new heights. It is the fundamental method of the Kellogg application-development laboratories. Recognized as among the finest in their field, a large part of their effort is directed toward translating basic theory into practical commercial plants.

To the continuous chemical-processing industry, the laboratories offer a particularly powerful engineering tool in their pilot plants. Accuracy so close to 100% is obtained in them that the findings can be directly projected to commercial scale... intermediate process-proving steps are eliminated.

This accuracy was of great value in the government's war aviation gasoline program. The same technique helped tremendously in the problems of designing the atomic-bomb plant, K-25*.

Aided by its accumulated technical data, Kellogg's unique application-development laboratories are currently working on many processes of interest to the chemicals industry. When the facts are documented, they will be made available to you.

*Engineered by the Kellogg subsidiary—The Kellex Corp.

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C. Carter and William de Back. A graduate of Stanford, Mr. Carter is the youngest officer in the organization, with which he has been associated for six years.

M. W. Kellogg Co., New York, has created two new executive positions. M. W. Kellogg is now chairman of the board and F. E. Johnson is vice chairman. Plans for widening operations provide for extended study of the commercial possibilities in connection with the company's work on the atom bomb project at Oak Ridge, Tenn.

Olin Industries, Inc., East Alton, Ill., has elected B. E. Bassett and Russell R. Casteel to the board of directors.

Foster Wheeler Corp., New York, has elected H. S. Brown as chairman of the board. He also will continue as president. David McCulloch was named chairman of the executive committee.

Monsanto Chemical Co., St. Louis, has appointed Donald Dunwody to the position of assistant branch manager of the New York sales district of the company's phosphate division. The district embraces Pennsylvania, New York, New Jersey, Maryland and the western part of Massachusetts and Connecticut.

Lincoln Electric Co., Cleveland, Ohio, has expanded the field engineering staff. John F. McFeeters has joined the staff in Kansas City, Mo. Hubert G. Hinkle has been assigned welding engineer in Columbus. K. S. Lamb has been named welding engineer in New York. Thomas W. Day has been sent to the St. Louis office.

Girdler Corp., Louisville, Ky., has selected Arne Eriksen to be western representative of both the gas processes division and the Votator division. He will have his headquarters in the Russ Bldg., San Francisco.

C. M. Kemp Mfg. Co., Baltimore, Md., has elevated Frank J. Kohut from sales-engineering supervisor to the post of sales manager.

Jessop Steel Co., Washington, Pa., has formed the Jessop Export Sales Corp. with offices in The Evening Post Bldg., New York.

Fenwal, Inc., Ashland, Mass., has elected two new directors. They are Edward J. Poitras director of engineering and John M. Storkerson general manager. Mr. Poitras was formerly with the Office of Scientific Research and Development in Washington.

Automatic Temperature Control Co., Inc., Philadelphia, in a move of policy revision, appointed Les Hunt direct factory representative for their home office territory.

Dayton Chemical Products Laboratories, Dayton, Ohio, was recently established. The office for the new concern is at 1150 W. Second St.

Tennessee Eastman Corp., Kingsport, Tenn., has established a new sales office in Rochester which will be in charge of Eugene C. Cathcart. Another sales office has been set up

A packaged pumping station

B.J SUBMERSIBLE

LOWERS THE BOOM ON WATER PUMPING PROBLEMS

The Submersible differs from all other types of deepwell turbine pumps. It is a major advancement in the design of such equipment. And it is manufactured exclusively by Byron Jackson.

PUMP AND MOTOR A SINGLE UNIT

The Submersible is delivered, ready for installation, as a compact, "packaged" pumping station: Submersible motor-pump unit, marine cable, weatherproof starting panel. The short-coupled Submersible consists of direct-connected motor and deepwell turbine pump. The motor-pump operates *entirely submerged in water.* It is connected to the column pipe and lowered to *any* well-depth. A surface plate attached to the top end of the column pipe rests on a foundation and suspends the column and the motor-pump unit. Only a discharge pipe and starting panel are at the top of the well. But nothing need show at the surface. Submersibles have even been paved over. The control switch can be located at a remote point, if desired.

Compact, weatherproof starting panel replaces the pump house.

Byron Jackson Co.

HOUSTON • LOS ANGELES • NEW YORK

SUBMERSIBLE ADVANTAGES

Shaft-type Installations Cannot Equal These

NO PUMP HOUSE—Motor-pump unit submerged. Only a weatherproof starting panel at surface.

NO ADJUSTMENTS—Precision factory assembly eliminates field adjustments during or after installation.

NO LUBRICATION—Motor-pump unit is sealed in oil.

YEARS OF AUTOMATIC, TROUBLE-FREE OPERATION

NO WELL TOO DEEP—Units perform equally well submerged a few feet or hundreds of feet.

CROOKED WELLS—Submersibles can be installed in wells too crooked for shaft-type pumps, because no drive shaft extends to the surface.

NO WATER CONTAMINATION—Motor oil sealed in motor case.

QUIET OPERATION—No motor or moving parts at surface.

UNAFFECTED BY ATMOSPHERIC CONDITIONS OR FLOODS

SAFE AGAINST VANDALISM

ENGINEERING DATA

Motor Sizes: 10 to 350 hp
Capacities: 50 to 10,000 gpm

in Toronto in charge of Robert R. Moore. The office of the representative in Buffalo has been discontinued.

Chas. Pfizer & Co., Inc., Brooklyn, has established a West Coast branch at San Francisco. Robert G. von Bernuth has been appointed manager.

B. F. Goodrich Co., Akron, has awarded the general contract for a new $4,000,000 plastics processing plant near Marietta, Ohio.

Ajax Electric Co., Philadelphia, has appointed A. A. Gustafson sales engineer. He will cover Minnesota, North and South Dakota, and northern Wisconsin. His headquarters are in St. Paul.

Bunell Machine & Tool Co., Cleveland, has promoted R. J. Swing to the position of general sales manager.

Worthington Pump and Machinery Corp., Harrison, N. J., has named P. A. Alers manager of the El Paso, Tex., office. Andrew S. Ormsby has joined the company as director of industrial relations.

American Locomotive Co., New York, has made arrangements to have Daniel Adamson & Co., Ltd., Duncanfield, Chesire, England, manufacture the complete heat transfer equipment line of the company.

Bowser, Inc., refrigeration division, Woodside, N. Y., has moved to enlarged facilities at Terryville, Conn. Offices will be maintained at New York, Washington, Chicago and San Francisco for sales and service staffs.

American Cyanamid Co., New York, moved the offices of the metropolitan district sales division, dyestuff department, of the Calco chemical division, to 30 Rockefeller Plaza.

Whittaker, Clark & Daniels, Inc., New York, has placed F. J. Hailer, Jr. on the company's sales staff. He will handle the line of non-metallic minerals in the New England area.

L. J. Wing Mfg. Co., New York, has appointed the Harang Engineering Co., San Francisco, as its representative for northern California.

Hendrick Mfg. Co., Carbondale, Pa., has returned Robert F. Couch to the firm as assistant to the sales manager.

Bristol Co., Waterbury, Conn., has placed H. A. Van Hala in the position of district manager of the Cleveland office. Charles Webber is the new managing director of The Bristol Co. of Canada. He will be in complete charge of the Canadian factory.

Reuland Electric, Alhambra, Calif., recently sold its Reuland small motors division to the Rheem Mfg. Co.

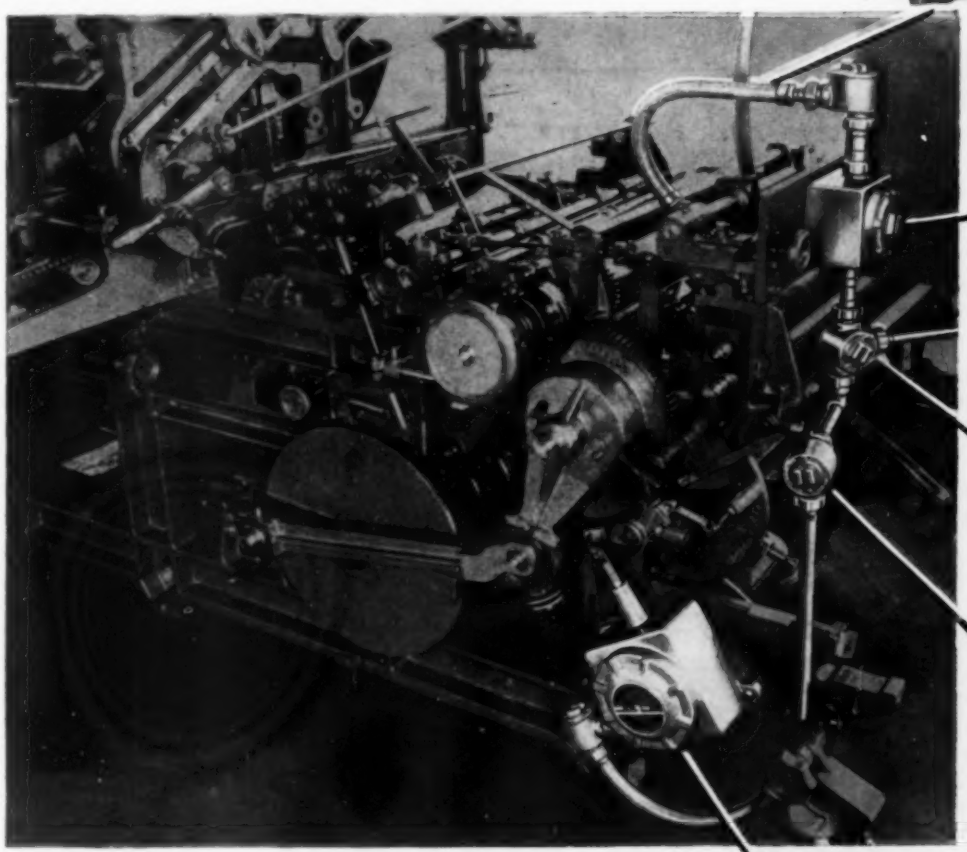
Ansul Chemical Co., fire extinguisher division, Marinette, Wis., has appointed Levitt Safety Appliances Co., Toronto, Ontario as its distributor for the provinces of Ontario and Quebec.

Explosion-Proof
CONDULETS

installed on machines that may operate in **flammable atmospheres**

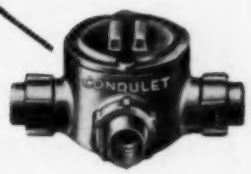
afford MAXIMUM SAFETY from explosion and fire

(CONDULETS are made only by CROUSE-HINDS)



EC Series Explosion-Proof Flexible Couplings are made in 325 types and sizes from 1/2 to 2-inch—lengths up to 36 inches.

Type GU Explosion-Proof Condulet. Can be furnished with any arrangement of hubs.



Type GUAT Explosion-Proof Condulet.

Type GUAB Explosion-Proof Condulet. There are 10 types in the GUA Series with either threaded or union hubs.

Locations where flammable atmospheres are likely to be present are designated as hazardous by the National Electrical Code. The Code requires that electrical installations on machines that operate in such locations, or that handle flammable liquids or gases, be explosion-proof. Crouse-Hinds Company manufactures hundreds of types and sizes of explosion-proof CONDULETS, lighting fixtures, plug receptacles and other equipment that afford maximum safety by preventing explosion and fire.

They are described in Crouse-Hinds CONDULET Catalog together with a complete line of similar equipment that is suitable for use on machines that operate under non-hazardous conditions.

Write to Crouse-Hinds Company for Condulet Catalog 2500. If you will state the nature of your requirements Crouse-Hinds engineers will be glad to make specific recommendations.

Type GUB Explosion-Proof Condulet. Can be furnished as an instrument housing or junction Condulet with any arrangement of hubs.

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CONVENTION PAPER ABSTRACTS

CONTENTS

ROSIN SOAP AS GR-S EMULSIFIER

It is well known that standard GR-S utilizes fatty acid soap as an emulsifier, in turn converted to free fatty acid when flocculated.

During the early phases of the government synthetic rubber program, it was shown that rosin acid soap could be substituted for fatty acid soap in the GR-S system with formation of polymer of good quality. Interest in this development was accelerated when it was observed that the polymer was tacky compared with standard GR-S and limited plant scale production was inaugurated during June 1943 under the code of GR-S X-10.

Subsequent experience in the building of tires from the rosin soap GR-S showed that considerably better quality was obtained because of superior adhesion between cords and adjacent carcass compounds. Further evaluation has demonstrated additional advantages, notably, better tensiles in low black compounds or with nonblack pigment loadings. The better reinforcement noted has sometimes resulted in better tread wear.

Rosin soap GR-S is now available in unlimited quantities under the designation GR-S: 10. A nondiscoloring, nonstaining variation is also available under the code GR-S: X-273.

Because of the lack of free fatty acid the rosin soap polymers break down somewhat slower and require more mastication. For the same reason, curing rates are slower than with standard GR-S and this must be compensated for by adjustment of accelerator ratio.

W. S. Coe and J. L. Brady, Naugatuck Chemical, before The Division of Rubber Chemistry, American Chemical Society, Atlantic City, April 10, 1946.

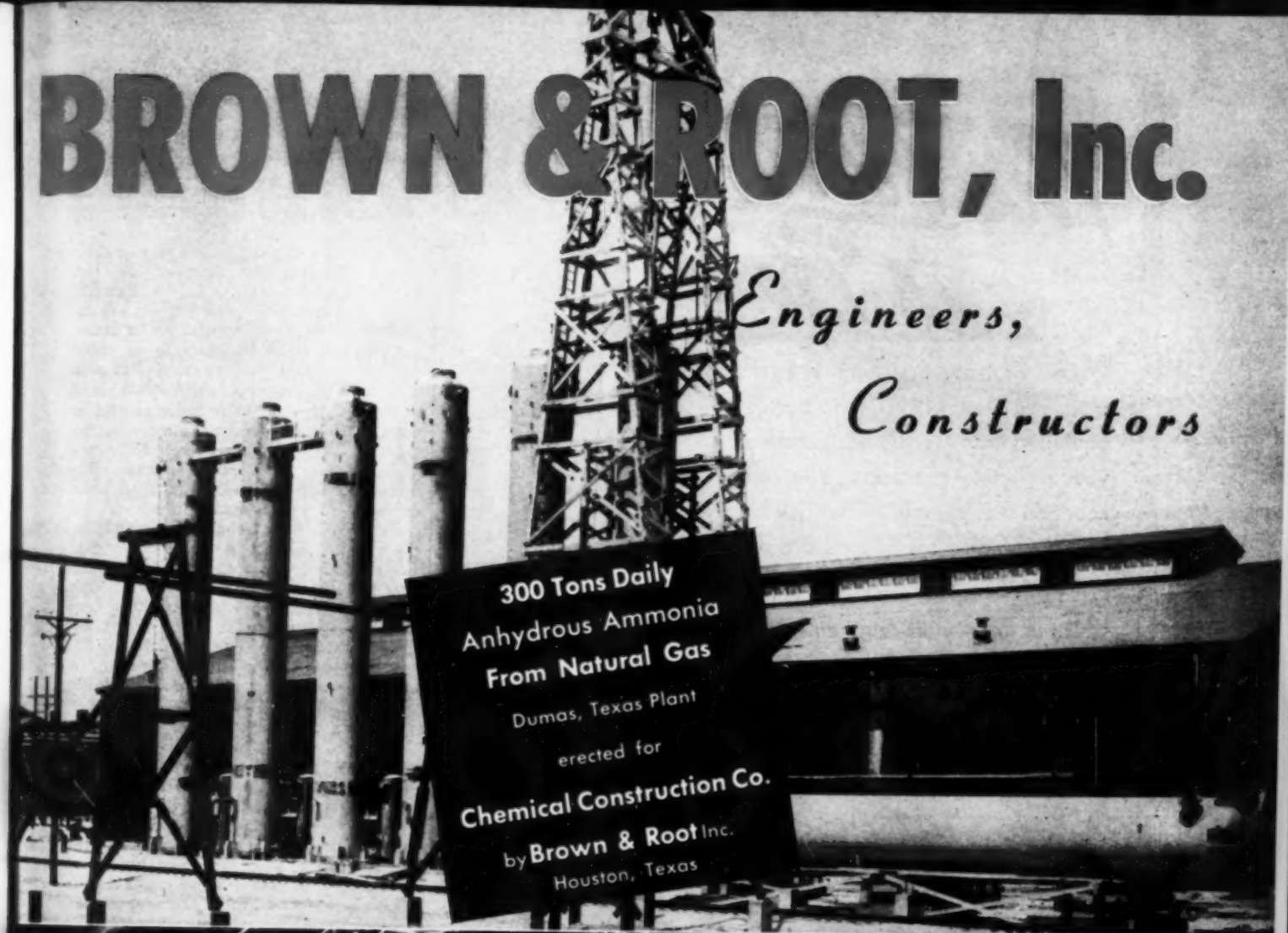
PLASTICS IN 1946

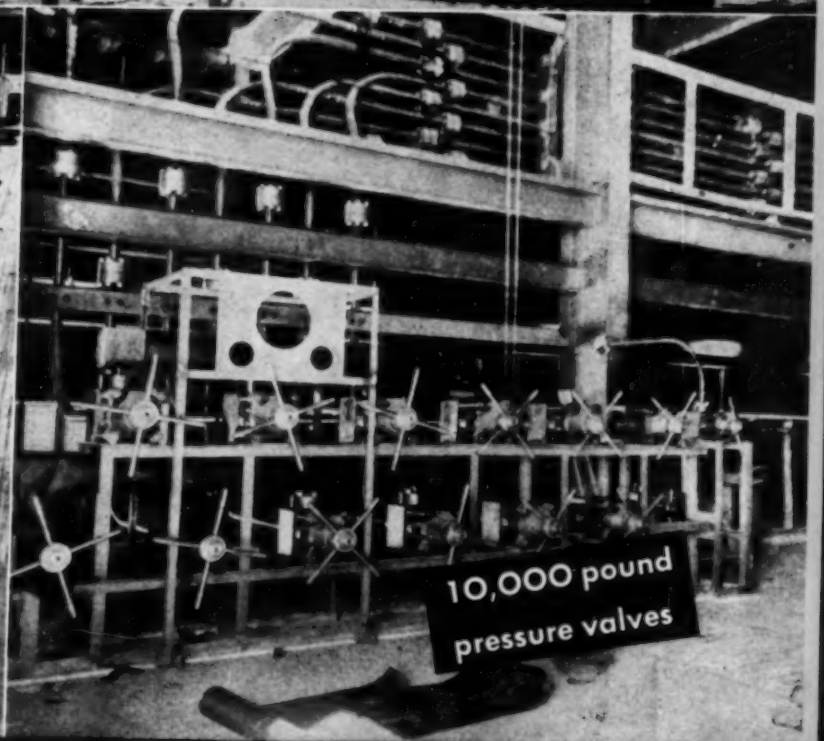
The plastics industry has just emerged from a period in which startling progress was made in broadening the fields of use for plastics and synthetic resins. Under the forced draft of military needs, with produc-

BROWN & ROOT, Inc.

Engineers,

Constructors





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★ FRACTIONATING AND TREATING OF REFINERY VAPORS

tion costs definitely a secondary factor, the technological progress of a decade was crammed into four short years. The benefit to the plastics industry was primarily in terms of new applications for existing types of materials—but distinctly new plastics were also developed to meet military requirements.

We are now entering the period when the plastics industry can capitalize on the knowledge accumulated, which will enable us to use more fully the intrinsic advantages of the plastics now made. Our laboratories are therefore beginning to put more and more emphasis on the creation of new plastics to fill those needs and wants.

To serve the new markets for plastics in general, substantial expansions in production capacity are now under way. Monsanto Chemical Co., as an example, is spending more than $40 million on additional plant facilities and, of this expansion program for the entire company, about 30 percent is for plastic raw material production facilities. For the industry as a whole it is estimated that the output of all plastic raw materials will be increased approximately 300 percent during this year. In terms of dollars, including the value of raw materials and finished molded and fabricated products, it means we are now a billion dollar industry and have definitely outgrown the lusty infant stage.

Prior to 1940 the commercially important thermoplastics, either as molding compounds or as sheets and rods for fabrication were: cellulose acetate, celluose acetate butyrate, ethyl cellulose and cellulose nitrate. The manufacturing process for the cellulose esters and ethers uses for a base cellulose, either cotton linters or wood pulp, primarily the first. In 1941 the total production of these cellulose thermoplastics for molding use was approximately 40,000,000 lb. The total tonnage of all other types of thermoplastic molding compounds was about 12,000,000 lb.

Thermoplastics derived from cellulose either as a byproduct of cotton ginning or from the pulp of timber amounted to a major part of all thermoplastics made in this country. Today we find a very marked contrast. It is estimated that cellulose plastics in 1946 will have a production rate of approximately 80,000,000 lb., or double the 1941 rate.

Vinyl chloride and copolymers of vinyl chloride will be produced during 1946 at a rate in excess of 100,000,000 lb.; polystyrene 150,000,000 lb.; other thermoplastics, including the acrylics, will add another 50,000,000 lb.; a total for these chemically synthesized thermoplastics in excess of 300,000,000 lb., or more than three times the total tonnage of cellulose base thermoplastics.

At the present time these various thermoplastic materials are truly not in competition with each other, because the total available supply of all thermoplastic materials is considerably short of filling the demand. At some point in the future, plastic materials will again begin to compete with each other on the normal basis of price and physical properties.

The future of the plastics industry is very closely tied to our ability to provide better materials than those which industry now has available. The plastics industry owes

From a trickle of dripping liquid to the full force of a hose during a plant washdown, Century Splash Proof motors will keep the vital parts of the motor dry — keep them in service longer. They eliminate unnecessary production losses due to dripping or splashing liquid or falling solids which might otherwise damage the vital parts of the motor.

Century Splash Proof motor windings are insulated to resist the damp atmospheres found where splash proof design is recommended. Special insulations are often provided for unusual concentrations of acids and alkali. This gives you additional protection against costly work stoppages.

These motors are ideal for installations on such equipment as pumps, conveyors, agitators, washers, dryers, and many others often encountered in food, chemical, and textile processing. In addition to splash proof designs Century offers a wide range of types and sizes from 1/20 to 600 horsepower.

Specify Century motors on all your electrically powered equipment. They are engineered to the functional characteristics of the machine theydrive to assure top performance.

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much to the beauty and novelty appeal of its early products which provided our industry with some of its early opportunities to grow. But beauty and novelty alone were not enough. Sound growth has been based on doing a wide variety of industrial production jobs better than it was possible to do them with any other type of material.

J. R. Turnbull, Monsanto Chemical Co., before Eleventh Annual Chemurgic Conference, St. Louis, March 19, 1946.

CHEMICAL INDUSTRY MOVES TO TEXAS

ALONG the Texas Gulf Coast there has been probably the greatest chemical industrial development of the war in any area of the Southwest. An investment by government and private industry of probably $1,500,000,000 and products valued at $5,000,000,000 since 1939, give an idea of what has happened in a region which ten years ago was largely a cattle-grazing domain or a cotton field. Many of these chemical war industries were based upon petroleum and waste gases of refining. Others used natural gas, sulphur, coal, magnesium from the gulf waters, gypsum and salt from huge underground domes which characterize the Texas Gulf Coast.

Texas is producing about 41 percent of the nation's total synthetic rubber of the butadiene type, from which most of our tires are being made. These chemical plants, however, are likely to see considerable modification during the coming years, as chemurgy comes more and more into the picture with the advance of technology and research. Already there is talk of such large firms as Dow Chemical Co., Monsanto, Du Pont, American Cyanamid and others to tap the vast resources of Texas and Louisiana forests of pines and hardwood trees. These offer great chemical opportunities for processing into every type of plastic material. Enormous volume of output of such raw materials will assure low cost of production.

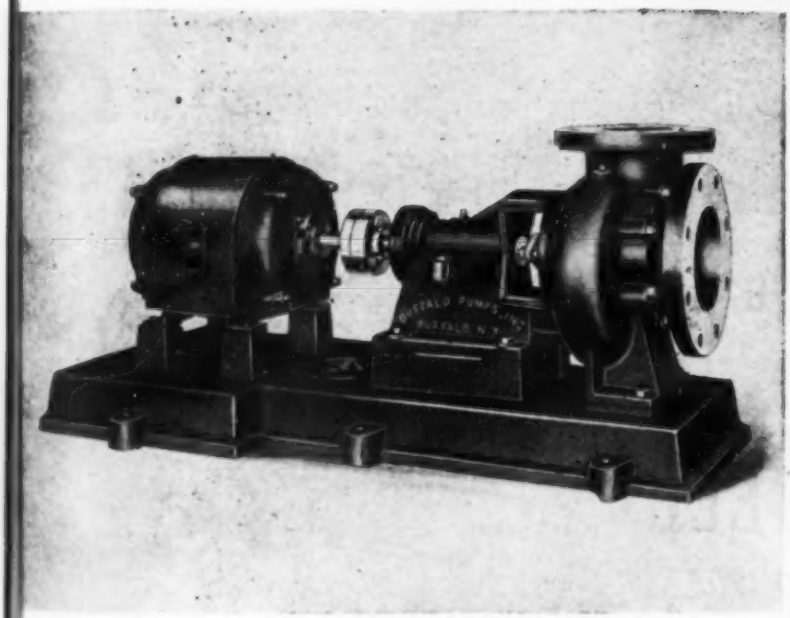
V. H. Schoffelmayer, *The Dallas News*, before Eleventh Annual Chemurgic Conference, St. Louis, March 20, 1946.

PATENTS ARE OUTGROWN, NOT SUPPRESSED

ALL the storm and fury to the contrary, there is no authenticated example of the actual suppression of a major industrial development which was patented and then monopolistically withheld in order to protect obsolete practices. An extensive survey conducted some years ago failed to reveal a single case of this kind. Frank Jewett, whose experience in this field is unexcelled, recently wrote: "Despite the fact that I have made diligent inquiry over the years, I had never been able to locate a suppressed patent nor have I ever found anyone who could cite an authentic case of suppression. The plain truth of the matter is that a large part of unused patents are worthless things which the inventors insisted on patenting and on which the Patent Office had to issue patents because the ideas presented were technically new and novel—the Patent Office does not pass judgment on the utility of the patents it grants."

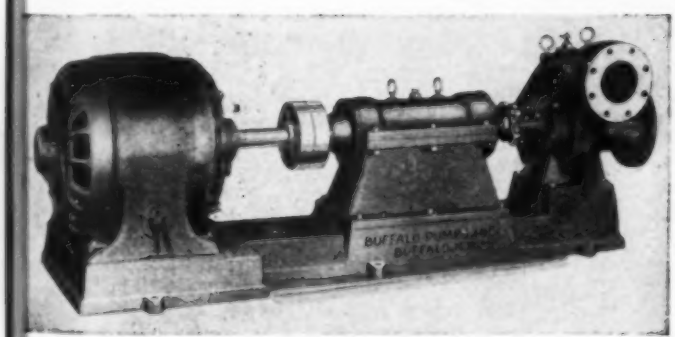
A very high percentage of patented in-

Built for "HARD-TO-HANDLE" Liquids-



Chemical plant operators present the most difficult problem to the pump manufacturer. The liquids they pump are frequently corrosive, often gritty, sometimes effervescent. In addition, they have temperature problems. On the favorable side, when they find equipment which gives satisfactory service, they are very loyal to it.

The chemical field is a very special one for Buffalo Pumps, Inc. In fact, it provides a very large portion of our total business. Naturally, we have concentrated our attention on the development of pumps for this field.



Buffalo Class "CS" and "CL" pumps were specially designed for chemical service. Solid shell, single suction types, they are husky, efficient and practical. Full ball bearing design, with heavy shaft, extra deep stuffing box, gives them continuous-service stamina. Superior rotor design gives high efficency. Hundreds are in service.

Bulletin 982 gives complete details on these and other types for chemical plant service. Write for your copy.

BUFFALO PUMPS, INC.
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"Buffalo"

Class "CS" & "CL" Ball Bearing Pumps

ventions almost certainly are not practiced for any length of time. No more than 20 percent, and perhaps as few as only 5 percent of all issued chemical patents, are not practiced. There are at least three reasons for this situation:

1. The industrial chemical field is characterized by highly competitive products, processes and techniques. Here if anywhere, technology is undergoing rapid and continuous change; the obsolescence factor is high. The industry thinks nothing of writing off a capital investment in expensive plant equipment in 10 years; a five-year amortization is frequently employed.

2. Because the process of obtaining formal patent coverage is indeed drawn out, frequently running to two or three years from the filing date, the invention may be outmoded before the patent issues.

3. The disappearance of an apparently stable source of raw material, the sudden development of entirely new processes, unorthodox engineering changes, can render whole industries essentially obsolete. The chemical industry is integrated to an extent seldom realized. The recent war taught us all over again that an unanticipated increased consumption of any one product can dislocate the whole pattern of production. With this circumstance the rule rather than the exception, it is completely understandable that the majority of chemical patents proves of no economic importance. They have not been "suppressed;" rather, they have been "outgrown."

E. R. Weidlein, Mellon Institute of Industrial Research, before National Association of Manufacturers, New York, December 7, 1945.

TRICRESYL PHOSPHATE

It was not until some years after World War I that the chemical industry showed the results of the tremendous surge toward chemical synthesis. However, early efforts during the first war did produce a compound, tricresyl phosphate, which today serves as an ideal synthetic hydraulic fluid and oil additive by virtue of unique physical and chemical properties.

During World War I when the Japs held a corner on camphor, it was decided to find not only as good a plasticizer but one that would render Celluloid non-flammable and odorless. It is not surprising then that a phosphate compound should lead to the choice of substitutes since the phosphate radical has the inherent property of not supporting combustion. This desire back in 1919 to not only overcome the high cost of Japanese camphor but also to reduce flammability of the finished product resulted in unexpected dividends years later. Production of tricresyl phosphate for the first time in history on a commercial scale in 1919 through the guidance of W. L. Lindsey (hence our trade name Lindol) saved the day for Celluloid.

With the return of low priced camphor and the subsequent American synthetic production, Celanese had an idle capacity for tricresyl phosphate. However, spraying was introduced using low viscosity pyroxylin lacquers. As an odorless nonflammable plasticizer, Lindol was on its way once again and production proceeded at capacity.

Lindol was subsequently replaced as the plasticizer in pyroxylin lacquers by the newer

FACT NO. 1 Hammond Multi-Wall Bags are *economical.* First cost is the *only* cost. No handling, cleaning, storage or freight charges on "returned containers." No "returned bag" nuisance.

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synthetic alkyl resins. But, in the scramble to find the elixir of oil additives, chemists tested hundreds of complicated compounds passing over tricresyl phosphate and leaving it to a minor appointed place in certain extreme pressure lubricants. By this time, however, Lindol earned a permanent place in the protective coatings field as a preferred plasticizer.

There are various theories as to what makes tricresyl phosphate tick. It is believed that the grouping of the several benzene rings increases the surface area of each molecule so as to maintain a large surface area per molecule even under high pressure. The alkyl radical of the molecule with respect to a horizontal film surface tends to increase the molecular thickness of the film preventing direct metal to metal contact between the moving surfaces. Studies have also advanced the theory that the phosphate radical under high temperatures creates at the high points of wearing surfaces a metallic phosphide which melts into the indentations thereby forming a smooth surface. Further, it is conceived by the compactness of the tricresyl phosphate molecule that the molecules act as ball bearings which resist compression, indeed, resist being mashed. Still another theory suggests polar activity with the individual molecules attracted or held to the metallic surface by electromotive attraction or a static effect. Coupled with this interpretation is that of tricresyl phosphate acting as a wetting agent forming a cohesive film directly over the metal surface.

The use of tricresyl phosphate as a hydraulic fluid is a relatively simple application as compared to its use as an oil additive. There is no other liquid medium involved which the tricresyl phosphate must police, so to speak. As a hydraulic fluid it is the lubricant and safety factor all in one. As an oil additive it is expected to blend with the mineral oil to conform to the ever increasing demands for compactness, speed, power and acceleration in modern engines. In other words it must be compatible with lubricating compositions to extend and widen the limits of straight lubricating oil. Tricresyl phosphate is a good neighbor among anticorrosive agents, detergents and oiliness agents.

E. G. Egan, Celanese Chemical Corp., before the New York Chapter, American Society of Lubricating Engineers, March 15, 1946.

ESTABLISH A RESEARCH DEPARTMENT

THERE are more than 17,000 manufacturing concerns in the United States whose gross sales exceed $500,000 and only 2,300 reported research activity to the National Resources Planning Board. Thousands of American manufacturing companies which now do no research must establish research departments if they are to hold their own in modern competition.

Even if a company can afford to pay the salary of only one research man, he can be of great value in keeping the management aware of what is going on in its field and in suggesting improvements in products. This advisory service is the principal function of the industrial research department regardless of its size.

While it may be true that only 1 or 2

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WELDED
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percent of the research department's time is spent advising management on technical matters, the fact is that 100 percent of the time is consumed with the view to performing this function. Facts are gathered by the best means from various sources, and correlated, designs prepared, alternates compared and finally the results translated from technical language to the well-understood universal language of business dollars and cents. The essentially creative purpose of most research efforts avails little unless the advisory function is effectively performed. The ultimate result of the research effort must be an improvement in the company's competitive position.

Change in industry is inevitable, and it is up to the research department to advise management on changes. This makes it important that the research unit report directly to the person or persons in management responsible for deciding on such changes. Many research department troubles result from the fact that this necessary relationship does not exist.

In a one-man department the industrial research director most often is a chemist or chemical engineer. Indeed chemists and chemical engineers are to be found in every nook and cranny of modern industry. In some units, every man, from the president down through the plant superintendent to the departmental foreman is professionally trained for the most part in chemistry or chemical engineering.

To a great extent the development of all new products and the improvement of established items depend on research. The chemists and chemical engineers in industry furnish the plans on which industrial progress is based.

M. H. Arveson, chairman of the Chicago Section, American Chemical Society, before Chicago Production Show and Conference of the Chicago Technical Societies Council, March 22, 1946.

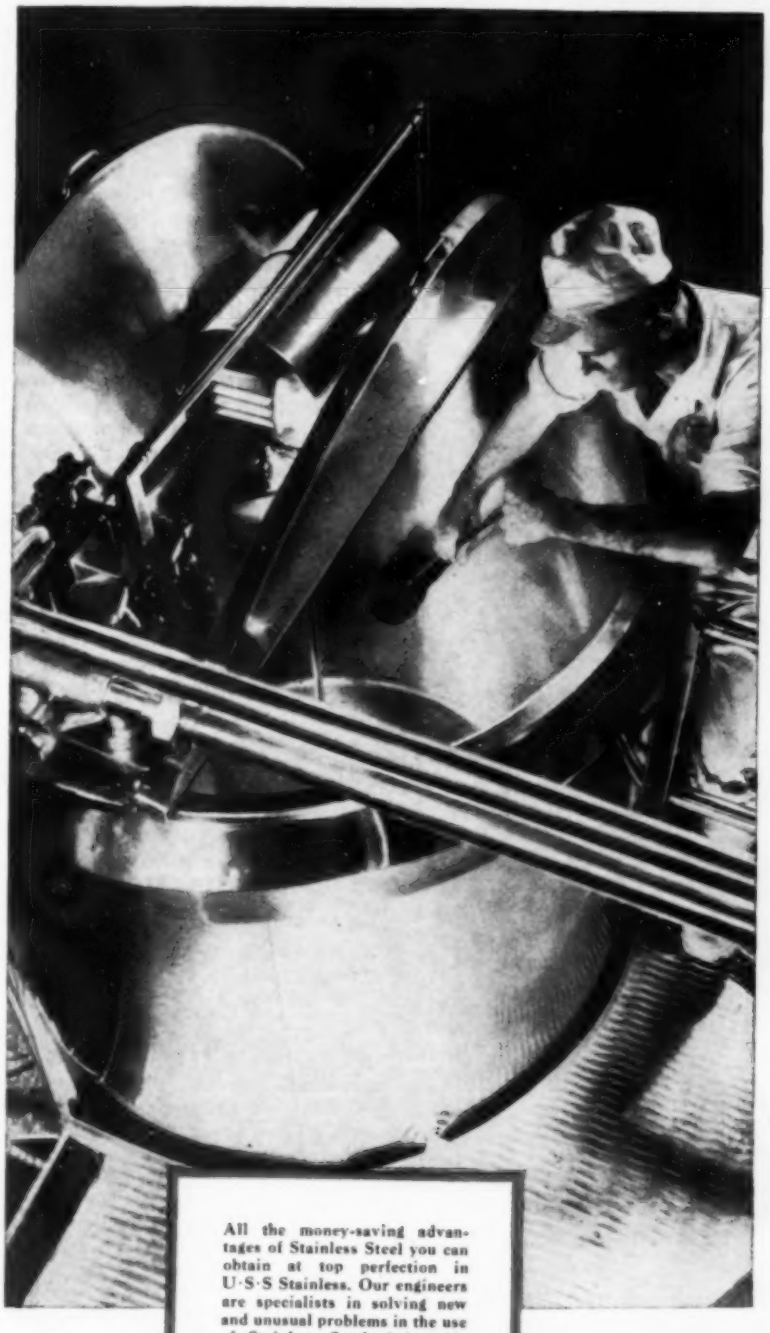
FOUR REGIONAL RESEARCH LABORATORIES

THESE laboratories were created for the purpose of searching for industrial outlets for farm products and to study food processing. Congress authorized an appropriation for the establishment of these laboratories in 1938 and directed the Secretary of Agriculture to establish one in each of the four major farm producing areas of the country. They were built for peacetime research centers, for national defense during the war. More than 150 research projects bearing on war effort were carried on in these laboratories during the war years.

One of the greatest accomplishments that has come from these laboratories is the important part the Northern Regional Research Laboratory at Peoria, Ill., played in developing methods for the commercial production of penicillin. Research at the Peoria laboratory started the ball rolling toward the commercial production of penicillin when scientists there discovered that the yield of the drug could be greatly increased by mold selection and by feeding the molds that produce penicillin on a controlled diet composed largely of two agricultural products—corn steeping liquor, a byproduct obtained in the manufacture of corn starch, and lactose or milk sugar.

The Southern Regional Research Labora-

TO CUT DOWN CLEANING TIME AND COSTS



—nothing equals Stainless Steel!

Ask anybody—the man on the street, the housewife, your plant manager, chemical engineer or maintenance man, especially ask the men who operate your equipment—what is the first thing that comes to mind when Stainless Steel is mentioned. The answer is always the same—*"It's clean. It's easy to keep clean."*

True enough. And this well-recognized attribute of Stainless results in important savings in time, money and labor.

A less well-known property that goes hand-in-hand with "cleanness" and which has similar highly desirable cost-cutting effects is Stainless Steel's *ability to resist adherence.*

It's a fact that many materials which adhere quite readily to common steel, or to coatings with which such steels are protected against corrosion, will not adhere to Stainless Steel.

These materials include a number of food products, dyes, gums from rayon and other textile products, wood gums and resins, and various materials encountered in chemical processing.

Stainless Steel rejects corrosion or solution by these materials to the point where they will not seize upon it.

As a result Stainless Steel equipment can be run for much longer periods without cleaning—errors in control of process temperatures cause less damage to equipment—spoiled materials can be cleaned and scoured away with less time and labor and with less damage to equipment.

All the money-saving advantages of Stainless Steel you can obtain at top perfection in U·S·S Stainless. Our engineers are specialists in solving new and unusual problems in the use of Stainless Steel—their wide experience is backed by the laboratory and research facilities of the world's largest producer of fine steel. Both are at your service to help you obtain optimum results with U·S·S Stainless.

USS STAINLESS STEEL — UNITED STATES STEEL

U·S·S STAINLESS STEEL

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*

United States Steel Supply Company, Chicago, *Warehouse Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

atory in New Orleans has just announced the results of 3 years of investigations in the development of improved cotton cord for use in automobile and truck tires.

High blood pressure is rated as the number one killer of people. And there are, as all know, many different types of this disease. The Eastern Regional Research Laboratory in Philadelphia has extracted a drug called rutin from flue-cured tobacco. The results of clinical observations show that this new drug is effective in the treatment of conditions arising from high blood pressure associated with increased capillary fragility.

The Western Regional Research Laboratory at Albany, Calif., has made some worthwhile contributions in food research. Velva Fruit, an ice-cream-like product that can be made from fully ripened fruit, much of which is often lost because it is frequently too soft for shipment to fresh fruit markets, is an example of a new outlet in the food field. The Western laboratory has also developed new food products in which modified pectin is used like gelatin or starch in powdered mixtures for preparing a jelly-like dessert.

The need for the type of research that is being done in these laboratories is greater today than ever before because farmers are facing the tremendous problem of adjusting expanded wartime production to normal peacetime needs. Research is definitely an investment in the future. Industry has used it for years and found that it pays high dividends; it is equally important in the agricultural field.

C. F. Speh, Bureau of Agricultural and Industrial Chemistry, before National Farm Chemurgic Council, St. Louis, March 18, 1946.

SILICONE RESINS FOR ELECTRICAL INSULATION

Tests on motors have demonstrated that silicone insulation has thermal endurance at least as great as was first predicted on the basis of rather meager tests on a few machines.

It is important to recognize that the use of silicone resins in electrical insulation need not represent any radical departures from well established practices. Inorganic components of high temperature insulation have long been available and their characteristics proved. It was the organic bonds, impregnants and surface treatments which limited the thermal endurance of composite insulation containing mica, asbestos and fibrous glass. Silicone resins should be used in combination with these well known materials.

Laboratory tests and many years of service experience have demonstrated that thermal aging is the most important single factor in insulation life. Only after such aging occurs does good insulation become vulnerable to other deteriorating factors. Differences in the thermal endurance of various types of insulation have been clearly demonstrated to be a function of the stability of their essential components. Therefore, the recent development of silicone resins promises great improvement in thermal stability of insulation for electrical machines as it improves the weakest link in the insulation system. This improvement properly utilized by designers can be a great asset to the industry. Nothing is gained by increasing operating tem-

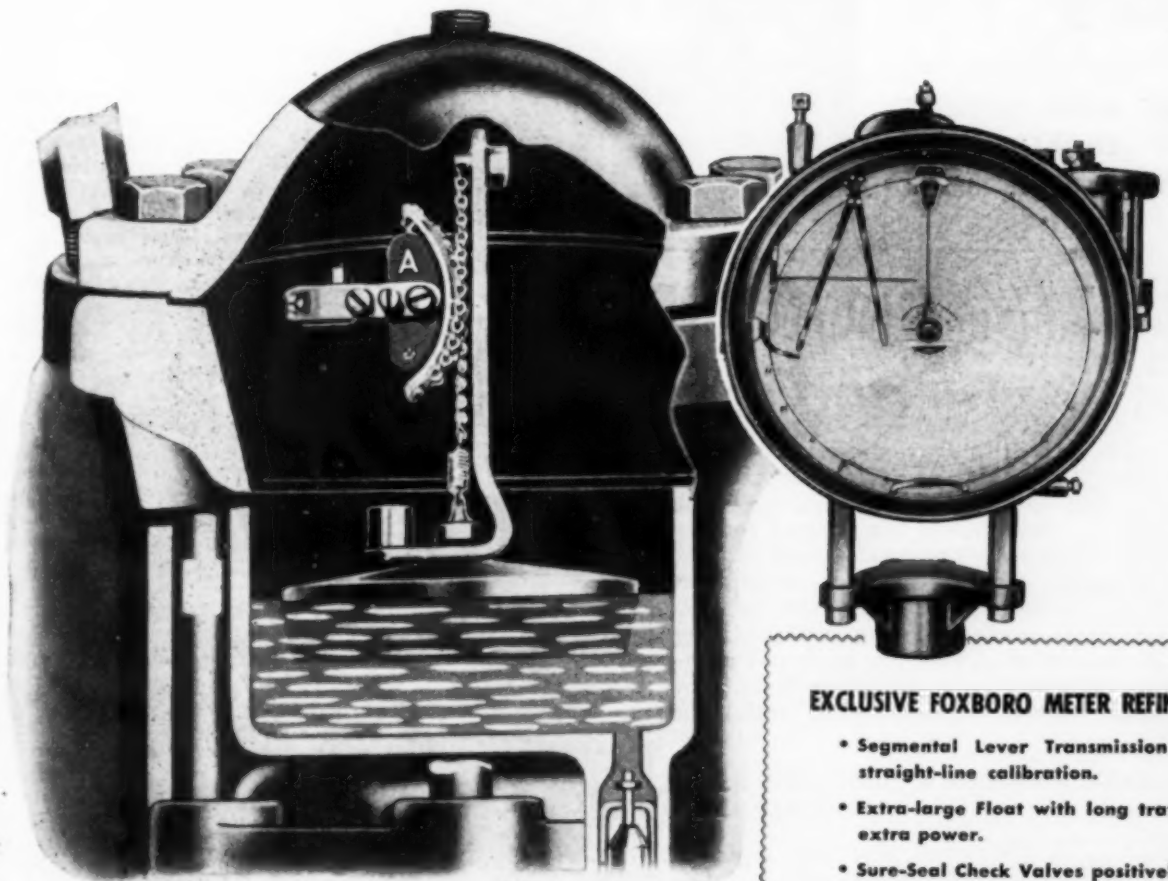
Yes... THERE IS A DIFFERENCE ...IN FLOW METERS!

In any piece of critical equipment you select, better-engineered design and construction make an important difference in the service it will give you. Flow meters are no exception.

For example, an important refinement found only in Foxboro Differential Meters is the patented Segment Transmission that gives straight-line calibration. It eliminates angularity errors of common levers and avoids the excess friction and lost motion of rack-and-pinion movements. Slightest changes in flow are recorded without error!

When you buy a Foxboro Meter, you get the extra value of many such exclusive features. In metering results, this better engineering gives you added accuracy and dependability . . . without added cost.

Write for Bulletin 200-7 which contains detailed information. **The Foxboro Company, 16 Neponset Ave., Foxboro, Mass., U. S. A.** Branches in principal cities.



The patented Foxboro Segment (A) produces straight-line calibration. The vertical motion of the float is transmitted through a unique, patented ladder-chain, giving positive transmission of the linear to rotary motion variables. Functions like a rack-and-pinion, but without the friction and lost motion of gear teeth.

EXCLUSIVE FOXBORO METER REFINEMENTS

- **Segmental Lever Transmission gives straight-line calibration.**
- **Extra-large Float with long travel for extra power.**
- **Sure-Seal Check Valves positively prevent mercury losses.**
- **Pressur-Tite Bearing eliminates stuffing box and packing.**

FOXBORO REG. U. S. PAT. OFF. **DIFFERENTIAL-TYPE FLOW METERS**

peratures unless some useful economic purpose is served, but where electrical machinery must operate at elevated temperatures, silicone resins and high temperature insulation offer a solution to a previously unsolved problem.

G. L. Moses, Westinghouse Electric Corp., before Midwest Power Conference, Chicago, April 3, 1946.

DOW PROCESS FOR STYRENE

Because of the large part played by styrene in the Synthetic Rubber Program, and because of its growing importance in plastic materials, a description of the Dow styrene process seems desirable. This process, used in whole or in part by six of the seven styrene plants in the United States and Canada, is producing about 90 percent of the total styrene made in this country.

The basic chemistry consists of: (1) Alkylation of benzene with ethylene in the presence of aluminum chloride to form ethylbenzene. (2) Catalytic dehydrogenation of purified ethylbenzene in the presence of steam to give styrene.

Flowsheets are presented for the three essential steps: ethylbenzene production, ethylbenzene dehydrogenation, and styrene finishing.

Basic raw materials are benzene and ethylene. Both coal-tar and petroleum byproduct benzene have been used successfully. Ethylene is purchased from Carbide and Carbon Chemicals Corp. at Texas City and brought by pipeline to Velasco. Other chemicals used are aluminum chloride, ethyl chloride, liquid 50 percent caustic, flake caustic, dehydrogenation catalyst, sulphur and *p*-tertiary-butyl catechol. Toluene is made as a byproduct. Steam at 400 lb. and 150 lb. pressures, power, service water, and fuel gas are obtained from the adjoining Dow sea-water magnesium plant.

When ethylene and benzene react in the presence of aluminum chloride and hydrogen chloride in an anhydrous system, alkylation of the benzene ring occurs to produce ethylbenzene and higher ethylated benzenes. Ethylene purity is not critical in this system as long as impurities are hydrogen, light paraffin hydrocarbons, or other inert materials. Acetylene is to be avoided. Its presence materially increases catalyst consumption. The purity of ethylene consumed at Velasco averages 95 percent, although the process at Midland has operated satisfactorily with concentrations as low as 83 percent. Benzene used corresponds to a purity slightly above 99 percent. Total sulphur should be below 0.1 percent. Aluminum chloride with a minimum purity of 97.5 percent is used as an alkylation catalyst.

In order to operate at high catalyst efficiencies, hydrogen chloride must be added as a promoter. This is accomplished by furnishing the reaction mixture with ethyl chloride, which in turn provides the desired HCl, as well as ethylene.

If one mole of ethylene comes to equilibrium with one mole of benzene at 95 deg. C., the resulting product contains by weight 18 percent benzene, 51 percent ethyl benzene, and 31 percent polyethyl benzenes. The quilibrium equation then gives: 0.58 C_2H_4 + 1.00 C_6H_6 equals 0.51 C_6H_6 + 0.41 ethylbenzene + 0.08 polyethylben-

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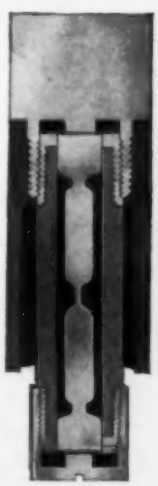

Sectional view of the Rowan time-tested Air-seal fuse.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE MD.

zenes as the reaction is carried on commercially. Benzene in the alkylated product is recycled. Polyethylbenzenes are returned to the reactor for dealkylation.

ETHYLBENZENE PRODUCTION

Benzene is received by barge or railroad tank car. One of the essential points in the operation of an aluminum chloride alkylation is the strict maintenance of anhydrous conditions. For this reason, an azeotropic drying column is employed on benzene fed to the alkylators. Overhead containing the constant boiling mixture of benzene and water is returned to a decanting tank where water is withdrawn from the system. Benzene containing less than 30 p.p.m. water is sent directly from this column to the alkylator.

Ethylene is metered as it leaves the pipeline and then is used to pick up ethyl chloride and carry it to the reaction zone for use as a catalyst promoter.

Aluminum chloride is dumped into a hopper of a screw conveyor which feeds the granular catalyst at a constant rate.

The alkylators operate with a liquid depth of about 34 ft. In this alkylation, aluminum chloride combines with hydrocarbons present to form a complex, which is practically insoluble in the hydrocarbon layer. It appears to play an important part in the reaction mechanism. The reaction of ethylene is quite complete. During smooth operation the ethylene lost in the vents is negligible. The exothermic alkylation is held at 95 deg. C. by means of an overhead condenser and cooling water running down the outside of the shell. Aromatic hydrocarbons are removed from the condenser vents. Crude alkylate, along with entrained complex, is cooled in drip-type exchangers. The stream passes to a horizontal cylindrical tank, where aluminum chloride complex settles out and is pumped back to the alkylator. The crude ethylbenzene is decanted once more in a second tank and sent to a caustic scrubbing system. Here a greatly oversize centrifugal pump, designed to run at low hydraulic efficiency, mixes 50 percent caustic solution and crude ethylbenzene. A tank serves as a settler in this system. Fifty percent caustic is charged to the tank periodically. When the caustic concentration has dropped to 30 percent, the charge is renewed. Another horizontal process tank serves as a final settler to remove any caustic solution carried over. Crude ethylbenzene, after thus being sweetened, is charged to a baffle-plate stripping column. Steam at 400 lb. pressure is used as a heating medium. Heavy materials pass out the bottom of the stripper to the polyethyl still. The overhead from the stripper enters the benzene column as a vapor feed. Benzene product is cooled and returned to the wet benzene feed tank. Bottoms from the benzene column, consisting of ethylbenzene and high boilers, are fed to the ethylbenzene column. The ethylbenzene product, at a purity of over 99 percent is cooled and sent to a caustic scrubbing system. Finished ethylbenzene is then dried by passing it through a bed of flake caustic.

Bottoms from the baffle-plate stripper enter the polyethyl still. The overhead product from this column combines with the bottoms from the ethylbenzene column, is cooled and used as absorption oil in the alkylator vent

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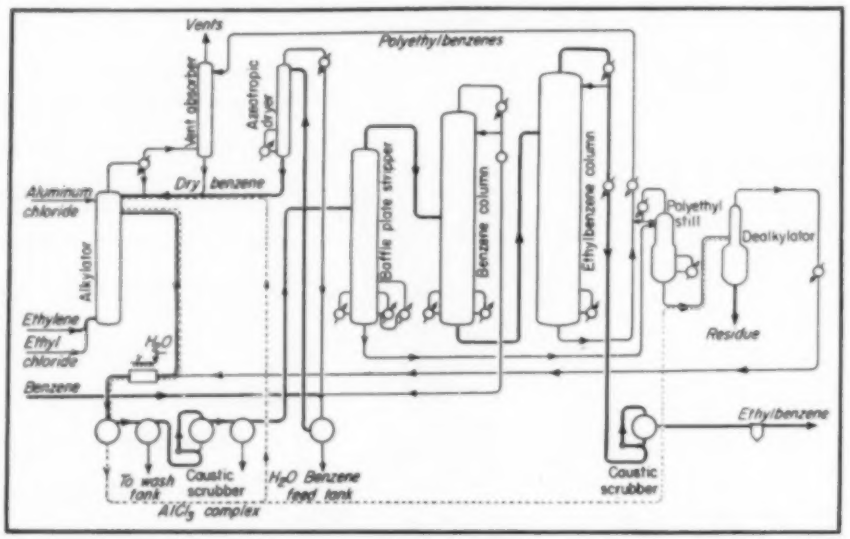
recovery system. These polyethyl benzenes pass through a small absorption column, picking up aromatics in the vents and returning them to the alkylator. The polyethyls themselves are dealkylated to ethylbenzene. Bottoms from the polyethyl still are sent to the high temperature dealkylator where a stream of aluminum chloride complex joins the hydrocarbons fed. The charge is broken down at a temperature of 200 deg. C. to benzene, ethylbenzene, and diethylbenzene, which pass overhead, and a tar-aluminum chloride residue. The overhead product is condensed and returned to the alkylator product stream.

DEHYDROGENATION STEP

Second important step in the manufacture of styrene is the dehydrogenation of ethylbenzene. In this endothermic reaction, a volume increase accompanies dehydrogenation so decreased pressure favors its progress. Rather than run this high temperature reaction under a partial vacuum, steam is used to reduce partial pressure of the reactants.

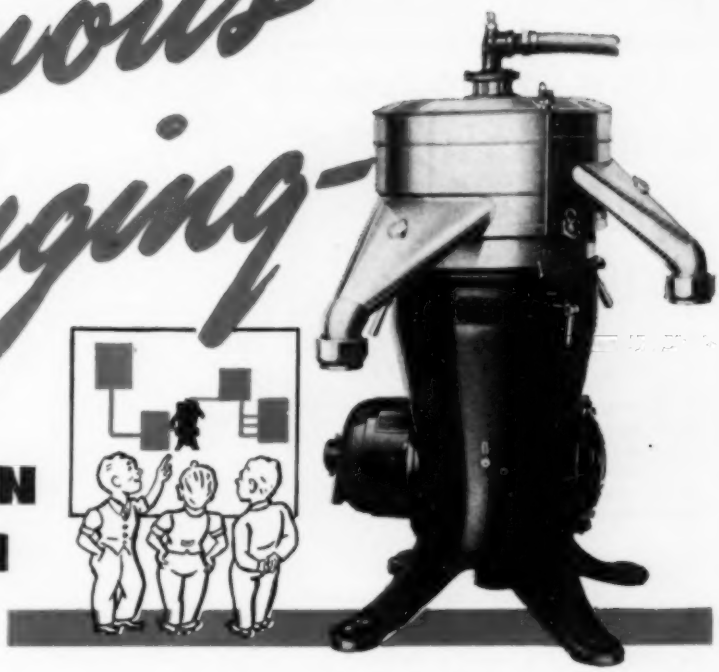
The dehydrogenation system's temperature

First step in the Dow process for styrene production



Continuous Centrifuging—

THE SHORTEST DISTANCE BETWEEN TWO PRODUCTION POINTS



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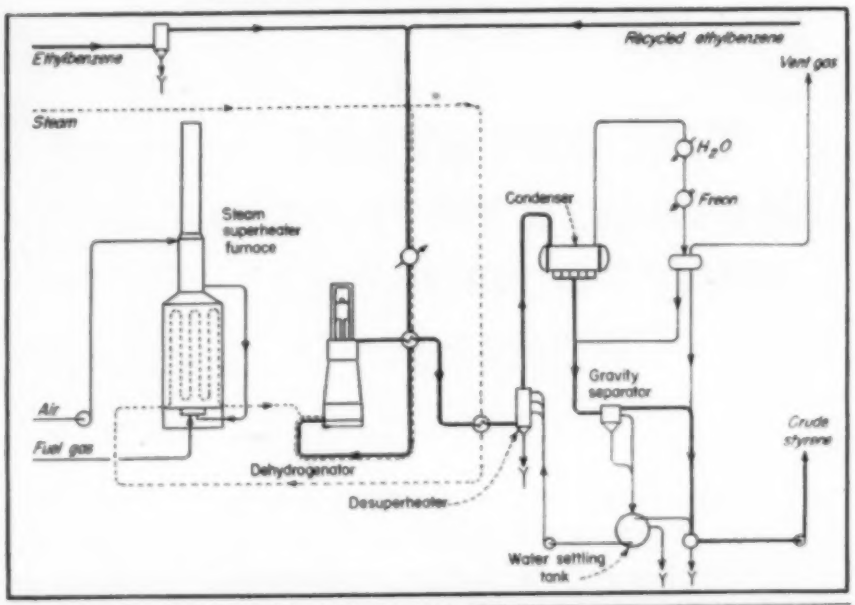
level varies considerably during the life of the catalyst. Fresh catalyst gives 37 percent conversion per pass at about 600 deg. C. As the catalyst becomes less active, the steam temperature is raised to provide a constant conversion.

Steam is fed at a rate of 2.6 lb. per lb. ethylbenzene. About 90 percent of this steam quantity is heat exchanged before entering the superheating furnace. The remaining 10 percent of the steam is mixed with ethylbenzene before being passed through a vaporizer. The ethylbenzene vapors meet superheated steam, the resulting temperature at the bottom of the catalyst bed is used for controlling the reaction system. Reactor product is cooled by heat exchange, first with incoming ethylbenzene, and then with steam. From this point a spray type desuperheater lowers the crude product temperature and condenses out tars formed at high temperature. Vapors then

Dehydrogenation of ethylbenzene—second step



CLEANING AND CORROSION TIPS

Issue No. 1

May — Published Monthly in the Interest of Advancing Metal Cleaning Progress — 1946

TODAY, MORE THAN EVER, industry's profits depend upon improved plant performance and reduced plant production costs. Costs, perhaps secondary to increased production during the war, must now be examined in minute detail. Each process—even those which apparently function efficiently—must be checked for further improvement. It is our aim to aid the metal cleaning departments in American industry in producing better cleaned products at a faster rate and at *lower cost.*

W. P. Drake
Manager of Sales
Pennsylvania Salt Mfg. Company

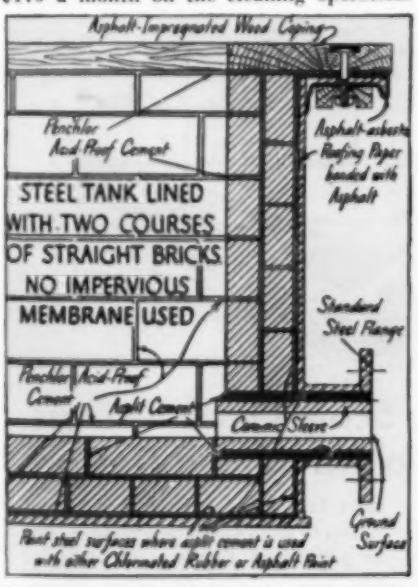
CASE NO. 401

Brass Company Saves $170 A Month in One Operation

Removing Buffing Compound Without Discoloration Was the Big Problem

A well-known brass company was busy turning out spigots and other plumbing fixtures. Rejects were numerous since cleaners strong enough to remove the buffing compound from the brass prior to chrome plating had a tendency to discolor the metal.

After studying the problem, a Pennsalt man with his technical experience suggested one of the Pennsalt Cleaners, which not only met the exacting requirements of the job, but actually saved on an average of $170 a month on the cleaning operation.



Cross-section view of a pickling tank in a large steel mill. Penn Salt's Perchlor Acid-Proof Cement and Asplit Cement used in its construction.

CASE NO. 425

Cleaning 3 Metals at Once Cuts Cost 20% for Silverware Maker

In cleaning stainless steel, britannia metal and brass pieces, this manufacturer had found it necessary to use a different cleaner for each metal. The Pennsalt man suggested a cleaner which now cleans all three metals in the same solution at one time in both electrolytic and still tank operations—and slices cleaning costs 20%.

CASE NO. 451

Pre-Cleaning Eliminated on Adding Machine Parts

Guided by the precision demands of such parts as springs, bearings, and key arms, an adding machine corporation had been using a laborious pre-cleaning operation prior to electrolytic cleaning. A recent survey of the setup by the Pennsalt man resulted in the adoption of a certain Pennsalt Cleaner. The pre-cleaning operation was eliminated entirely and over-all cleaning costs were reduced about 60%.

CASE NO. 455

One Cleaning Process Replaces Three

Furniture Maker Finds Slow, Costly Hand Operations Unnecessary

Prior to electrolytic cleaning, tube frames in this factory were first given a sawdust cleaning followed by an actual hand-scrubbing operation.

A Pennsalt Cleaner, adopted on the recommendation of a Pennsalt man, with his knowledge of advanced metal cleaning, now cleans the tubing thoroughly in one operation and prepares the surface properly for the exacting chrome plating operations. Costly hand operations are out, production costs are down.

CASE NO. 475

Electrical Products Metal Cleaning Costs Down 28%

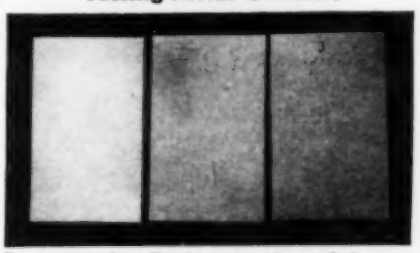
Use Same Cleaner Before Plating or Enameling

A maker of electrical products had experimented with many different makes of cleaners, trying to get junction boxes of low carbon steel really clean. Finally, he was forced to use one cleaner for those boxes to be enameled and another for those to be plated.

When the Pennsalt man was called in, he studied the problem and then, with his practical knowledge of cleaning methods, suggested a single Pennsalt Cleaner which is now cleaning both types of junction boxes thoroughly (for the first time) and actually cutting cleaning costs 28%.

THE LAB NOTEBOOK

Ultra Violet Light Aids in Testing Metal Cleaners



In testing the effectiveness of metal cleaners it is always necessary to know when the surface is clean. The use of ultra violet light immediately reveals unremoved soil (oils and greases) as shown by the above picture taken under ultra violet light. These tests were made at the Whitemarsh Research Laboratories.

YOU NEVER CAN TELL

Take the case of the production manager for one of the nation's largest automobile manufacturers. He was glad to see the Pennsalt man the morning he called. Not because the production manager had a problem. On the contrary, he was anxious to show the Pennsalt man, who had never visited this plant before, the efficiency of his cleaning setup.

As the two of them watched the cleaning operations, one question led to another; the Pennsalt man told the production manager the latest developments in advanced metal cleaning, and the plant's cleaning operations developed an entirely new aspect. Thinking along these lines, new cleaning ideas crystallized, until shortly, the production manager knew how the seemingly efficient cleaning operation could be materially improved.

As a result of this exchange of ideas, this automobile company's metal cleaning is now being done by a new method and with a Pennsalt Cleaner. Now as much cleaning is done in 320 man-hours as formerly required 3,000 man-hours.

THE POINT IS: No matter how efficient your cleaning operations are, the Pennsalt man may be able to help you turn out *better work . . . faster . . .* at a *lower production* cost.

If you would like to see the Pennsalt man, write to Dept. CME. If your problem is urgent — wire, and he will call immediately.

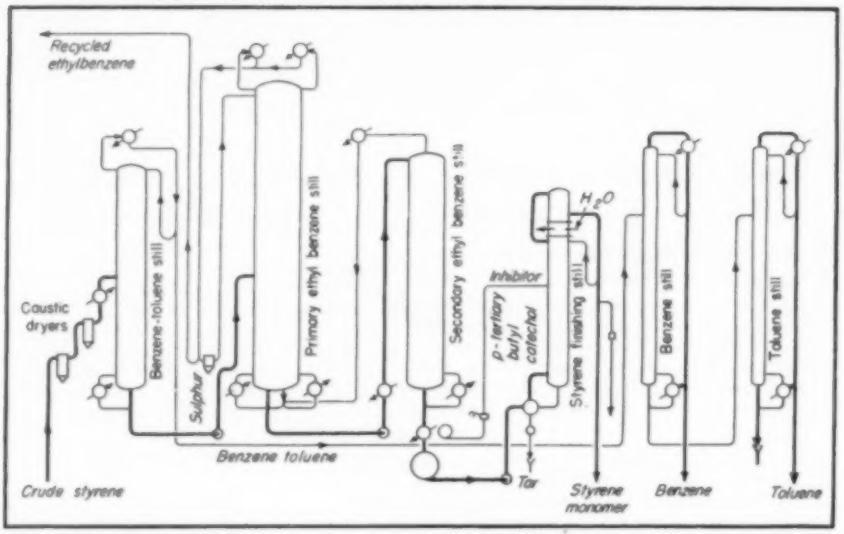
enter the final condenser, where steam, styrene, ethylbenzene, benzene, toluene, and small amounts of tar are liquefied. Vent gases pass to a refrigerated recovery system.

Condensed materials go to a gravity separator, where the hydrocarbons are decanted from the water phase. After further settling, part of the water is recycled to the sprays of the desuperheater, and the rest is discharged to a disposal system. The hydrocarbons pass to another settler, where insoluble tar can drop out along with entrained water. Crude styrene is then pumped to storage. An average percent composition for this stream by weight is: 37.0 styrene, 61.1 ethylbenzene, 1.1 toluene, 0.6 benzene, 0.2 tar.

STYRENE FINISHING

Third and final step is the purification of the crude dehydrogenated material. The fractionation requirements are rather strict. Not only the styrene product, but also recycled benzene and toluene must be of very high purity. Only by a combination of vacuum operation, suitable inhibition of styrene, and special column design can styrene be distilled succesfully. Relatively trouble-free

Final step-purification of styrene and recovery of toluene and benzene



COMPLETE PLANTS AND EQUIPMENT FOR

PRODUCTION AND RECOVERY OF...

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HYDROCARBONS – PHENOLS
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Economic Analysis of Requirements

Process Development

Process and Equipment Design

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operation can be had by distilling inhibited styrene in a system which never allows the concentrated monomer to exceed 90 deg. C.

Crude styrene is dried by passing it through a bed of flake caustic. The stream then passes through a pot containing sulphur where enough is dissolved to act as a polymerization inhibitor. After preheating, the feed enters the benzene-toluene column where benzene and toluene pass overhead. Sulphur passes down the column and effectively inhibits the stripping zone. Benzene and toluene then pass to a benzene column of standard construction operating at atmospheric pressure. Benzene, thus purified is recycled to the ethylbenzene plant for alkylation. The bottoms from this column contain toluene and traces of ethylbenzene. Toluene is obtained as product from the toluene column. This byproduct has been used for aviation gasoline blending stock and for explosives. Ethylbenzene, styrene, and tar then pass to the primary ethylbenzene column. At this stage comes the difficult separation of ethylbenzene from styrene. The separation is split into two steps: the primary ethylbenzene column, which acts as the top 38 plates, and the secondary ethylbenzene column acting as the bottom 32 plates. Vacuum jets and cooling water keep the top of each at 35 mm. Hg, and thus, the bottom temperatures can be held at a safe level of 90 deg. C. Bottoms from the secondary column are cooled to prevent polymerization and then pass to a batch still charge tank which is held at 25 mm. Hg pressure. Batch styrene finishing stills consist of 3½ ft. diameter packed columns 36 ft. high. Their purpose is to remove tar and sulphur from the styrene. Batch operation permits easier handling of the residue and also gives greater flexibility to the system. Product purity is recorded continuously on a strip chart by a specially designed infrared analyzer. Top temperature is 50 deg. C. at a pressure of 25 mm. Hg. A solution of *p*-tertiary-butyl catechol in styrene is pumped into the reflux to this still by means of a proportional pump. Five p.p.m. of inhibitor are effective in preventing excessive polymer formation. The residue from these columns consists of tars formed in the dehydrogenation step, styrene-sulphur compounds, elemental sulphur, and styrene.

Product styrene which passes overhead then goes to receivers. Here catechol is added to bring the concentration to a minimum of 10 p.p.m. Inventories of this high purity styrene are held at a minimum. Shipment of the finished material is made in insulated tank cars.

J. E. Mitchell, Jr., Dow Chemical Co., before American Institute of Chemical Engineers, Chicago, Dec., 1946.

NOMENCLATURE OF SULPHUR COMPOUNDS IN PETROLEUM

A STUDY of the nomenclature of groups of compounds which contain carbon, hydrogen, and sulphur and which may occur in petroleum and its products results in the following recommendations: (1) The thiols or mercaptans should be designated by the suffix "thiol." (2) The sulphides, both open-chain and cyclic, should be named by using the term "thia" in conjunction with the name of the corresponding hydrocarbon to indicate a sulphur atom substituted for a carbon atom. (3) The disulphides would

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receive "dithia" names. (4) The identity of the thiophene nucleus should be retained in naming substituted thiophenes.

J. S. Ball and W. E. Haines, Bureau of Mines, before Division of Petroleum Chemistry, American Chemical Society, Atlantic City, April 10, 1946.

PHOTOGRAPHS OF MOLECULES

ALTHOUGH the arrangements of atoms in many types of molecules had previously been deduced from X-ray data, it was only recently that a way was found to get actual pictures of molecules and their component atoms directly from such data. First step in this process is to obtain an X-ray diffraction photograph from a crystal of the substance being studied. This picture does not look like the crystal, since it consists merely of a pattern of spots, but it yields data concerning the crystal's structure that form the basis for a second photographic step in which successive exposures on a single sheet of photographic film or paper are made through certain masks—films having on them patterns of properly spaced and oriented bands.

The final result of this process is a picture of the crystal's unit cell and the molecules and atoms within it. When such a picture was made of a molecule of the dye phthalocyanine, the arrangement of the atoms in the molecule was found to be precisely that previously deduced by organic chemists.

M. L. Huggins, Eastman Kodak Co., before Rochester Section, American Chemical Society, Jan. 21, 1946.

FOREIGN LITERATURE ABSTRACTS

BRACONYL INSECTICIDE

Anthonomus pomorum L. is a small weevil of 4-5 mm. length. Its larvae, upon hatching, devour the essential organs of the apple blossom. The petals thus attacked acquire a reddish color and the buds remain closed. The methods so far recommended for combating this pest are as follows: shaking the trees and capturing the adults, collecting and destroying the unopened buds, using glue-covered bands or traps. A new method has been proposed for chemical combat using a product called Braconyl which consists essentially of a mixture of glycerides of aliphatic acids and sulphides of polychlorocyclane. This product is applied with a sprayer under a pressure of 28 kg. Tests were made to determine the number of treatments, date of treatments, and their resulting effect on the vegetation. The results obtained led to the following conclusions: Braconyl is very effective against the *Anthonomus*; the great activity of the product appears to be due to the effect of synergism developed by the association of the two components. Under these conditions the insecticidal effect on the adults and eggs seems to take place simultaneously. The best time for treatment is the period of pairing which just precedes egg-laying. This biological stage corresponds to the so-called vegetative stage of the "white

● This illustration shows clearly how the installation of these nine radiators was simplified by using WeldOlet Fittings for making the branches to each radiator.

The use of these fittings made it unnecessary to cut and thread the run pipe for each take-off. Instead, the entire line was laid in position, holes cut in the run pipe with a torch and the WeldOlet Fittings welded in place. WeldOlet Fittings with threaded outlets were used further simplifying the assembly of the branch line.

In addition to simplifying the job, the use of these fittings provided leakproof joints of full pipe strength. WeldOlet Fittings also provided improved flow conditions into each branch because of their exclusive funnel-shaped inlet.

On your next heating or other piping job, it will pay you in time, money, performance and permanence to use WeldOlet Fittings for making your branch pipe outlets. To get complete information on these modern fittings, write today for a copy of the new WeldOlet Fittings Catalog. It will give you complete data on their applications and specifications.

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bud." A second treatment can be given 7-8 days later. Braconyl does not harm the vegetation.

Digest from "New Chemical Method for Combating the Apple Weevil (*Anthonomus pomorum L.*)," by R. Bouchet, *C. R. Acad. Agric. France* **40**, No. 14, 349-353, 1944; *Chimie et Industrie* **53**, No. 1, 45, 1945. (Published in France.)

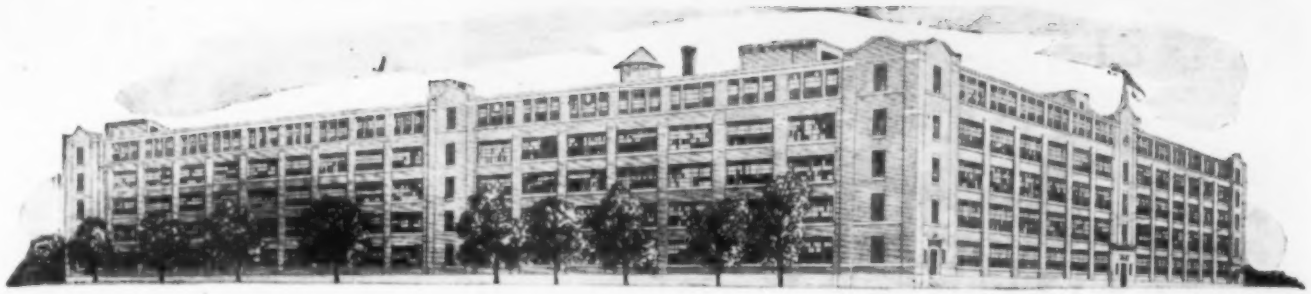
BENZENE HOMOLOGS

NORMAL octyl benzene was prepared by the Fittig reaction rather than the Friedel-Crafts reaction in order to avoid even partial isomerization of the normal octyl chain. This hydrocarbon had a boiling point of 255.5-257.5 deg. at 747 mm. pressure; d(20/4), 0.8550; n(18/D), 1.4850; MR_D: found—63.59; calculated—63.25; kinematic viscosity (Ostwald) 0.0285 stokes at 20 deg. and 0.015196 at 50 deg. The pour point was —39.5 deg. C. and the cetene number 36. Propylphenyl carbinol was synthesized from butyraldehyde and phenyl magnesium bromide and converted by oxidation with chromic acid into a ketone which was then converted to propyloctylphenyl carbinol. On heating with oxalic acid, this carbinol yielded an olefin having a boiling point of 117-120 deg. under 1 mm. pressure, which, when hydrogenated over platinum black, yielded propyloctylphenyl methane. This compound boiled at 138-141 deg. at 3 mm., had a specific gravity of 0.842, a kinematic viscosity (Ostwald) of 0.0721114 stokes at 20 deg. The pour point was —24 and the cetene number 48. An alkyl chloride was prepared from dibutylnonyl carbinol which had been made from the ethyl ester of capric acid and n-butyl bromide. This chloride was used in the synthesis of dibutylphenylnonyl methane by the Friedel-Crafts reaction. This hydrocarbon had a boiling point of 182-185 deg. at 6-7 mm.; d(20/4), 0.8559; n(12/D), 1.4846 MR_D: found—109.72, calculated—109.43; kinematic viscosity (Ostwald) 0.12638 stokes at 20 deg., 0.07074 stokes at 50 deg. The pour point was —48 deg. C. and the cetene number 66. Analysis of this hydrocarbon conformed to the formula $C_{28}H_{52}$. According to this investigation, only alkylation of benzene by high molecular tertiary alkyl can give low pour point components of aviation diesel fuel of satisfactory antiknock properties.

Digest from "Synthesis and Properties of Some Higher Homologs of Benzene," by A. D. Petrov, E. I. Lapteva and A. N. Pchelkina, *Zhurnal Obshchei Khimii* **14**, 495-7, 1944. (Published in Russia.)

CHLORINATION OF SILICATE-OXIDIZED NICKEL ORES

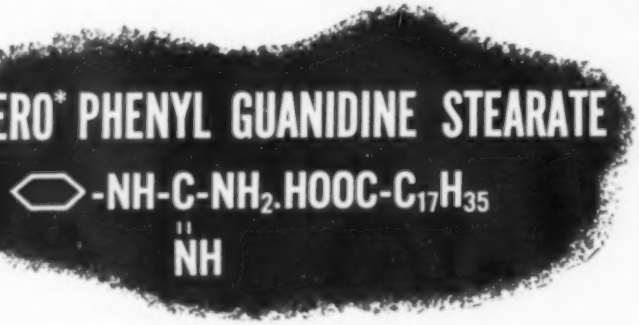
SILICATE-OXIDIZED nickel ores which contain nickel in the silicate and oxidized form can be treated effectively by means of chlorination. Chlorination of garnierite and other silicate compounds of nickel by means of gaseous chlorine takes place with considerably more difficulty than chlorination of nickel monoxide. Chlorination of garnierite starts at approximately 280-290 deg. C. Increase in the temperature from 300 to 900 deg. is accompanied by a corresponding increase of from 4.01 to 89.2 percent in the degree of chlorination of the garnierite under the conditions of the conducted experiments. Complete chlorination of the garnierite under the given conditions can be attained



NO. 8 OF A SERIES OF DIGEST REPORTS FROM CYANAMID RESEARCH LABORATORIES

INTERESTING OPPORTUNITIES FOR SYNTHESIS WITH PHENYL GUANIDINE SALTS

AERO* PHENYL GUANIDINE STEARATE



AERO Phenyl Guanidine Stearate is the salt of a strong organic base and a fatty acid and therefore falls into the general category of "soaps." It is potentially valuable wherever detergent or wetting properties are desired or as a lubricant additive.

AERO Phenyl Guanidine Stearate is a light tan waxy solid with a slight fatty acid odor. The table below summarizes some of the physical properties of this material.

Molecular weight	419
Melting point	Softens at 60°C. or 140°F.
pH of water solution	8.5 at 25°C. (less than 1% solution)
Purity	Approximately 95%
Solubility	
Water	Small amounts are dispersible in warm water
Ethyl Alcohol (95%)	Very soluble
Benzene	Soluble

This compound is available in research quantities for your evaluation.

Should the solution of your problem indicate some other phenyl guanidine salt, it is suggested that you request a sample of AERO Phenyl Guanidine Carbonate which can be used as an intermediate in the preparation of a series of phenyl guanidine salts.

For additional technical information and samples address Section ND, Synthetic Organic Chemical Department, American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York 20, N. Y.

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OTHER CYANAMID ORGANIC NITROGEN COMPOUNDS:

Acrylonitrile	$CH_2:CH-CN$
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Guanylurea Compounds	$H_2N-C(:NH)-NH-C(:O)-NH_2$
Glycolonitrile	$HO-CH_2-CN$
Lactonitrile	$CH_3-CHOH-CN$
Dicyandiamide	$H_2N-C(:NH)NHCN$

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in the temperature range of 1,100-1,150 deg. Reduction of the garnierite considerably increases the degree of chlorination of this mineral and, therefore, considerably decreases the temperature of the complete chlorination of the garnierite. The maximum degree of chlorination of garnierite is obtained by combination of the processes of direct reduction of the garnierite and its chlorination and, therefore, the processes of reduction and chlorination of silicate-oxidized nickel ores must be conducted simultaneously under practical conditions. Extraction of the nickel from the garnierite depends very little on the content of nickel therein and this method therefore guarantees practically complete extraction of the nickel not only from poor ores but also from waste silicate-oxidized nickel ores. Presence of moisture does not have a particularly bad effect on the chlorination process of the garnierite and chlorination of silicate-oxidized nickel ores can therefore be carried out without preliminary drying. Nickel chloride formed in the process of chlorination of the garnierite at temperatures of up to 400 deg. remains entirely in the chlorinated garnierite. Chlorination of the garnierite at higher temperatures is accompanied by partial volatilization of the nickel chloride in quantities which are fairly large even at 600 deg. Further increase in the temperature of the chlorination process is accompanied by considerable increase in the quantity of volatilized nickel chloride. Chlorination of the garnierite at 800 deg. is accompanied by complete volatilization of all the nickel chloride formed. Two new methods were developed for treatment of silicate-oxidized nickel ores by reduction and chlorination: (1) Reduction of the ore and its chlorination in the temperature range of 400-500 deg. with subsequent extraction of the nickel and other chlorides with water and (2) reduction of the ore simultaneously with its chlorination at a temperature near 800 deg. with elimination and condensation of the nickel and other chlorides.

Digest from "Methods of Chlorination of Silicate-Oxidized Nickel Ores," by D. P. Bogatsky, *Zhurnal Prikladnoi Khimii* XVII, 6, 346-353, 1944. (Published in Russia.)

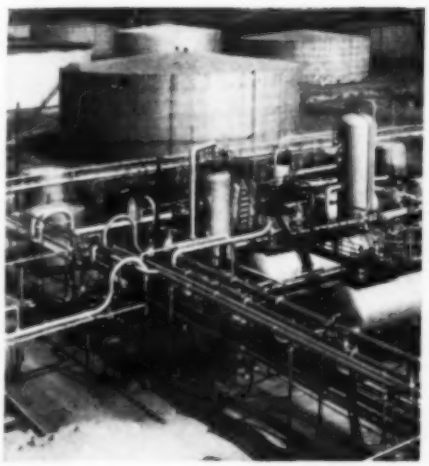
INHIBITING COMBUSTION OF MAGNESIUM WHILE POURING

For a long time combustion of magnesium at the moment of pouring has been prevented by sprinkling it with sulphur. The author has shown that many other substances could have the same effect, particularly fluorides of boron and of silicon, and fluoride, chloride, fluoborate and fluosilicate of ammonium. Some new experiments have been made to study the action of a current of air containing the inhibiting gas on the flaming metal. When the air contains 0.5 percent of silicon fluoride or boron fluoride, the inhibiting effect already manifests itself. Strengths of 0.3 to 1 percent of silicon fluoride and of 0.2 to 1 percent of boron fluoride, suffice to extinguish the flame. Water has quite a marked effect in accelerating the combustion. Water vapor plays a role of first importance, often misunderstood, in the casting of magnesium.

Digest from "Inhibition de la combustion du magnesium et de ses alliages," by R. Delavault, Le Genie Civil, Feb. 15, 1946.

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor



PRODUCT OF FREEDOM

OUR OIL RESOURCES. *Edited by Leonard M. Fanning. McGraw-Hill Book Co., New York. 331 pages. $4.*

As a political force of the first magnitude, oil resources have been and will continue to be a vital determinant in the history of nations jockeying for real and potential power. It is rather surprising, therefore, that so little factual material has been written on so serious a subject. Nations fight, threaten to fight or appease in order to gain control over oil resources; the seeds of the final defeat of Nazi Germany were sown millions of years ago by climatic and geologic conditions that were not favorable to the formation of reserves of oil in Teutonic Europe.

Just what is meant by the term "oil reserves?" Is the United States declining to a second-rate power because of too rapid depletion of its petroleum resources? Basing industrial and military potentials upon oil productivity, what nation has the trump cards for future leadership in peace or war? How does technology, the great multiplier, alter the picture? And why has free enterprise been so important in the development of our petroleum industry? Finally, what are the real prospects for economic production of liquid fuels from our coals and tremendous beds of oil-bearing shales and sands?

To those persons concerned with such questions, this book will provide many of the answers. It is probably the most exhaustive study on our oil resources that has been attempted in recent years by highly qualified authorities—sixteen of them, to be exact. It is the story of the petroleum industry in the United States, what has made it great and why it will remain a dynamic force for peace for many decades to come. With facts and logic, the authors reaffirm our faith in the future virility of the American oil industry, for petroleum is a product of freedom, initiative and enterprise, and technological democracy.

OILWELL PRINCIPLES

PETROLEUM PRODUCTION. *Vol. I, Mechanics of Production: Oil, Condensate, Natural Gas. By Park J. Jones. Reinhold Publishing Corp., New York. 228 pages. $4.50.*

WRITTEN for the petroleum production engineer, this book brings together under one cover the known principles and most of the available data on the mechanics of producing oil, condensate and natural gas. Many of the data are in table, chart and graph form for use by practising engineers. This present volume treats of the mechanics of producing oil and condensate prior to the breakthrough of displacing fluids into the producing wells. Later volumes in the series are scheduled to deal with optimum rate of production; reserve and well spacing; condensate and natural gas production; primary and secondary methods of oil production.

SECOND PRINTING

HACKH'S CHEMICAL DICTIONARY. *Third edition, 1946 printing. Edited by Julius Grant. The Blakiston Co., Philadelphia. 925 pages. $8.50.*

IT IS good to be able to report, in these times of inflation, that something new is cheaper then its predecessor without any sacrifice of quality. Such is the case with Hackh's dictionary. Price of the third edition has been reduced nearly 30 percent while value has been increased.

On looking through the second printing one discovers that it has the same number of pages as the first. However, a cursory examination reveals more than three dozen newcomers. Room was made for them by dropping and shortening other less important entries. For example, there are now definitions for streptomycin, plutonium, lyovac process, penicillic acid, tweens, and a number of sulfa compounds. Samples of those now omitted are spasmotoxin, penetrating, suchar and tylmarin. Several definitions have been changed, modernized or corrected. These include uranium, sulfa drugs and, (we are glad to report) nylon.

There are still a few definitions that should be changed, a few typographical errors to correct and a few more chemicals to be added. Nevertheless, Hackh's continues to be one of the few really indispensable volumes on any chemical reference bookshelf aiming at completeness.

UNINTEGRATED

AN OUTLINE OF ORGANIC NITROGEN COMPOUNDS. *4th Edition. By Ed F. Degering and Collaborators. University Lithoprinters, Ypsilanti, Mich. 752 pages. $7.50.*

Reviewed by Robert C. Krug and F. C. Nachod

THIS book is a reorganized and enlarged version of the third, planographed edition and contains considerably more material. It is a lithoprinted text in which the topics are classified with code numbers, somewhat in the manner of a card index. It is stated in the preface that "this book is not intended to include the sum-total of the chemistry of organic nitrogen compounds" and it is also stated that it might be "too inclusive for use as a good textbook." Unfortunately both statements appear to be quite correct.

The material is arranged as in the previous edition, in the form of an outline. The first chapter is a brief but good chronological survey of the birth and development of the chemistry of the organic compounds of nitrogen. The next chapter deals with some general concepts of chemical bonds, bond energies and a rather detailed presentation of the theory of electronegativity. It is the opinion of these reviewers that the authors overemphasive the principle of relative electronegativity to the expense of such factors as inductive, electromeric and resonance effects, leading to oversimplification.

The arrangement of the subject matter leaves much to be desired. For example chapters XV, XVI, and XVII present the amino acids, polypeptides and proteins respectively. These three classes of compounds are so very closely related that a separation into three chapters is certainly not advantageous. Chapter XL on high polymers of nitrogen content should logically follow here, but the reader catches up with it some 350 pages later. A similar situation is encountered in the case of urea and its derivatives. The chapter on alkaloids is exceedingly brief (14 pages) and the arrangement of material is poor. The chapter on the nitroparaffins, aromatic nitro-compounds, the diazenes, isocyanates, and pyridine are good and include excellent bibliographies.

We think it is regrettable that data on such a large class of compounds as the porphyrins were not included, and that chlorophyll was mentioned only in the historical survey.

In the opinion of the reviewers the book lacks integration, a factor so essential in a good textbook. Yet the book might be useful as a supplement or as a general reference. The research worker will be disappointed as the book is not comprehensive enough for such extended usage. In this

connection the chapter on medicinals containing nitrogen may be cited.

In the field of the chemistry of organic nitrogen compounds, the need of an up-to-date comprehensive and readable treatise is great. The reviewers cannot and do not recommend this rather high-priced outline to those who desire more than a very general survey of the classes of compounds discussed.

CARTEL CONCEPTS

INTERNATIONAL CARTELS. *By Ervin Hexner. The University of North Carolina Press, Chapel Hill. 555 pages. $6.*

Reviewed by R. S. Aries

THE CONFUSION which exists at present on the subject of international economic intercourse necessitates analyses of cartel practices based on facts. This book is a contribution to our knowledge of the subject, although most of the case material seems to be derived from sources rather hostile to industry, probably because they are more numerous.

International cartels are accused of blocking technological progress; of restricting trade; of hampering an equitable distribution of products. Cartel members are accused of wanting political power and greedily seeking material wealth. After reading Dr. Hexner's evidence, this reviewer is of the belief that the above is hardly the case of the bulk of chemical cartels. Most of the evidence against chemical concerns is taken from the hearings of the Bone Committee on patents, TNEC hearings and Department of Justice sources. Although they reflect the popular belief at the time that "cartels are something bad . . . and secret, un-American, contracts with foreigners," there are many indications of competition between the big chemical concerns. In some cases it is even doubtful whether the agreements were actually practiced, even though they existed.

Since agreements on chemical processes rather than products predominate, it is hard to understand how controls based primarily on patents and exchange of technological information can be termed "marketing cartels."

The book presents a clean-cut description of the cartel concept, the structure and policies of international cartels as well as their political repercussions. It should provide interesting reading to the executive and technical personnel of our chemical and related industries. It gives data on metals, chemicals, miscellaneous raw materials and manufactured goods and is recommended to both the layman and the student of chemical economics.

THE USES OF GLYCERIN

GLYCERIN, ITS INDUSTRIAL AND COMMERCIAL APPLICATIONS. *By G. Leffingwell and M. A. Lesser. Chemical Publishing Co., Brooklyn, N. Y. 259 pages. $5.*

IF ANYONE is looking for a literature survey on the uses of glycerin, this is it. Leffingwell and Lesser have exhaustively reviewed patent and other references to this industrial chemical which is important in so many process and other industries. These references have been classified. The data from them are presented in 26 chapters ranging through the various applications from ad-

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A polished face of a diamond 7,700 X—Note residual polish marks and pits in depressions.*

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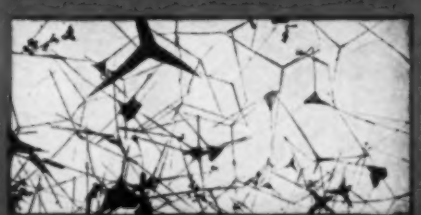

Zinc Stearate (ZnO) magnified 3,750 times.

*A collodion replica, metal-shadowed to produce three-dimensional effect. Courtesy R. W. G. Wyckoff and R. C. Williams.

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SCIENTIFIC INSTRUMENTS

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hesives to veterinary medicine. Each chapter gives various uses of the compound in the particular industry and numerous recipes (most are from patent literature) are included. As a review of the literature of glycerin and a starting point for a study of its uses, this book is an important contribution.

RECENT BOOKS and PAMPHLETS

Index to ASTM Standards. Published by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 211 pages. Annual publication.

For a Stronger Congress. By P. S. Broughton. Pamphlet No. 116, published by Public Affairs Committee, 30 Rockefeller Plaza, New York 20, N. Y. 32 pages; 10 cents. Examination of existing plans for reorganization. A critical aid for the inquiring citizen.

Elements of Ammunition. By T. C. Ohart. Published by John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. 412 pages; $6. Explosives, primers, detonators, tracers; small arms, artillery, aircraft, pyrotechnic, rocket and miscellaneous ammunition; ammunition packing. A standard handbook for all those interested in explosives, chemicals, ordnance, military education and allied fields.

ASTM Standards on Paint, Varnish, Lacquer, and Related Products. Published by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 528 pages; $2.75. Fifth edition containing more than 160 standards.

Public Relations for Hazardous Products. By L. W. Hutchins. Available from Safety Research Institute, 420 Lexington Ave., New York 17, N. Y. 6 pages. Reprinted from Public Relations Directory and Yearbook.

A Business of My Own. By A. E. Morgan. Published by Community Service, Inc., Yellow Springs, Ohio. 184 pages; $1. A contribution to small business by the former president of Antioch College. An exploration of the possibilities in small community occupations and industries.

1946 Directory. Published by Society of the Plastics Industry, Inc., 295 Madison Ave., New York 17, N. Y. 275 pages. A directory of company and professional members. Includes a who's who, also product, material and machinery indexes.

Food Industries Manual. Fourteenth edition. Edited by T. Crosbie-Walsh. Published by Leonard Hill, Ltd., 17 Stratford Place, W. 1., London. 1,062 pages. A directory and encyclopedia for the food industries of Great Britain.

The Birth and Death of the Sun. By George Gamow. Penguin Book No. 4, published by Penguin Books, Inc., 245 Fifth Ave., New York, N. Y. 219 pages; 25 cents. A reprint. Origin, life and probable fate of a small star—our sun.

Alcohol: Its Place in Organic Chemistry. By H. H. Hatt. Bulletin No. 187, published by Council for Scientific and Industrial Research, Commonwealth of Australia, Melbourne. 51 pages. Raw materials, uses, and alcohol and the Australian chemical industry.

Rubber Red Book. 1945 (fifth) edition. Published by The Rubber Age, 250 West 57th St., New York 19, N. Y. 692 pages; $5. Biennial directory of the rubber industry. Manufacturers, equipment, materials and products.

The President's National Labor-Management Conference. Bulletin No. 77, available from Division of Labor Standards, U. S. Department of Labor, Washington 25, D. C. 89 pages. Official summary of the proceedings of the conference held last November.

Planning of Research and Development Work. By Dwight L. Williams. Published by Wallace Clark & Co., 521 Fifth Ave., New York 17, N. Y. 27 pages. Planning for research; a statement of the experience of a firm of consulting management engineers.

Introduction to X-Ray Metallography. By A. Taylor. Published by John Wiley & Sons, 440 Fourth Ave., New York, N. Y. 400 pages. $7.50. Introduction to an essential tool in metallurgical research.

What's Ahead for the Veteran? By Ted Handelman. Published by National Foremen's Institute, Deep River, Conn. 21 pages. 15 cents. What every veteran should know and practice.

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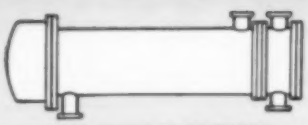

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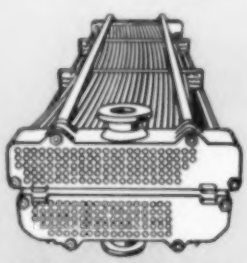

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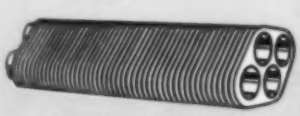

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GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper covers unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the bureau responsible for its issue.

Effects of Elevated Curing Temperatures on the Strength and Durability of Yellow Birch Plywood Joints Made with Room-Temperature-Setting Urea Glues. By John M. Black, W. Z. Olson, and H. D. Bruce. Forest Products Laboratory, Madison, Wisconsin. No. 1339. Processed.

Comparison of Commercial Water-Soluble Phenol-Formaldehyde Resinoids for Wood Impregnation. By Horace K. Burr and Alfred J. Stamm. Forest Products Laboratory, Madison, Wisconsin. No. 1384. Processed.

Distribution of Strength Values in Wood for Aircraft Construction. By J. T. Drow, M. E. Clark, and T. R. C. Wilson. Forest Products Laboratory, Madison, Wisconsin. No. 1515. Processed.

Impact Resistance of Three Core Materials and Six Sandwich Constructions as Measured by Falling-Ball Tests. By K. H. Boller. Forest Products Laboratory, Madison, Wisconsin. No. 1543. Processed.

Fire-Retarding Coatings. By Arthur van Kleeck. Forest Products Laboratory, Madison, Wisconsin. No. R1280. Processed.

A Wood-Element Hygrostat. By Seymour J. Johnson and E. F. Rasmussen. Forest Products Laboratory, Madison, Wisconsin. No. R1602. Processed.

Paint Manual With Particular Reference to Federal Specifications. By Percy H. Walker and Eugene F. Hickson. National Bureau of Standards. Building Materials and Structures Report BMS105. Buckram. Price $1.

Fluorescent Lamps. National Bureau of Standards, Letter Circular LC-817. Mimeographed.

Dampness in Basements and Ground Floors. By Richard S. Dill and Douglas E. Parsons. National Bureau of Standards, Letter Circular LC-813. Mimeographed.

Underground Corrosion. By Kirk H. Logan. National Bureau of Standards, Circular C450. Buckram. Price $1.25.

Flameproofing of Textiles. National Bureau of Standards, Letter Circular LC-818. Mimeographed.

The Bicarbonate Process for the Production of Magnesium Oxide. By H. A. Doerner, W. F. Holbrook, and Otis W. Fortner. Bureau of Mines. Technical Paper 684. Price 10 cents.

The Thermodynamic Properties of Manganese. By K. K. Kelley, B. F. Naylor, and C. H. Shomate. Bureau of Mines, Technical Paper 686. Price 10 cents.

Beneficiation of Montana Chromite Concentrates by Roasting and Leaching. By R. R. Lloyd, O. C. Garst, W. T. Rawles, J. Schlocker, E. P. Dowding, W. M. Mahan, and C. H. Fuchsman. Bureau of Mines, Report of Investigations R. I. 3834. Mimeographed.

Metallurgical Treatment of Cobalt Ores from the Goodsprings Mining District, Nevada. By F. Keith Shelton. Bureau of Mines, Report of Investigations R. I. 3836. Mimeographed.

Mining and Concentration of Missouri Valley Manganese at Chamberlain, S. Dak. By Leon W. Dupuy, W. A. Calhoun, and R. T. C. Rasmussen. Bureau of Mines, Report of Investigations R. I. 3839. Mimeographed.

Pilot-Plant Investigations on the Preparation of Alumina From Potassium Alum. By C. T.

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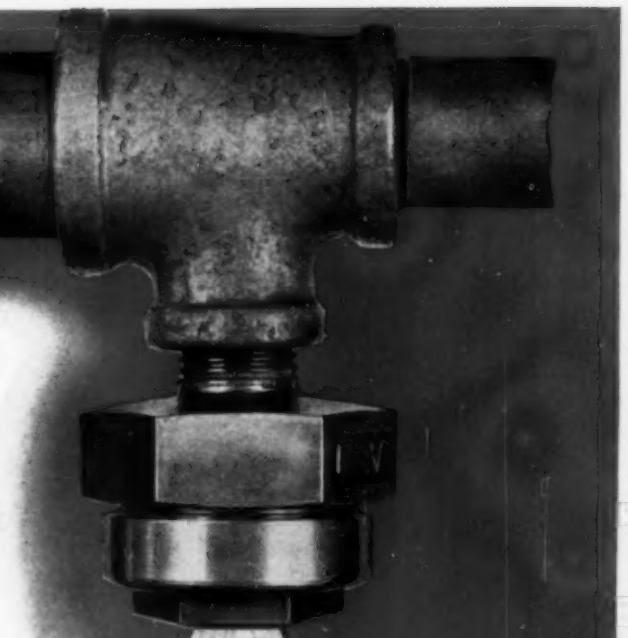

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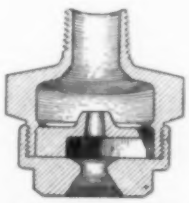

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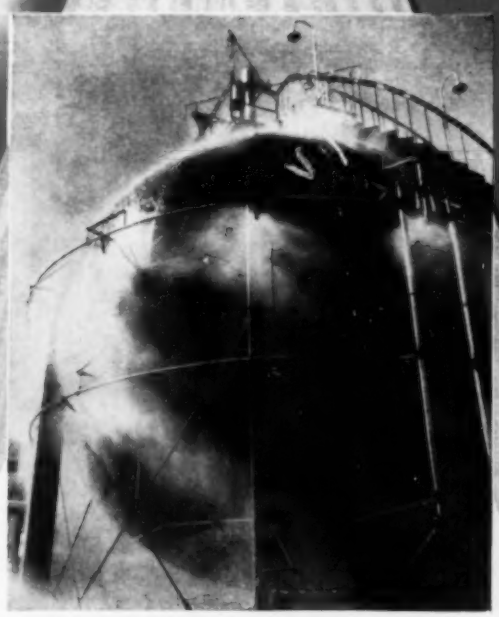

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Baroch, A. W. Hackwood, and R. G. Knickerbocker. Bureau of Mines, Report of Investigations R. I. 3845. Mimeographed.

Evaluation of Some Binders for Use in Pelletizing Slimes. By T. A. Klinefelter. Bureau of Mines, Report of Investigations R. I. 3846. Mimeographed.

Selective Reduction of Iron in Chromite by Methane-Hydrogen and Similar Gas Mixtures. By F. S. Boericke. Bureau of Mines, Report of Investigations R. I. 3847. Mimeographed.

Sensitivity of Explosives to Initiation by Electrostatic Discharges. By F. W. Brown, D. J. Kusler, and F. C. Gibson. Bureau of Mines, Report of Investigations R. I. 3852. Mimeographed.

Exploration of the Hog Creek Corundum Mine, Towns County, Ga. By T. J. Ballard. Bureau of Mines, Report of Investigations R. I. 3855. Mimeographed.

Mine Rescue Life-Line Telephone Assemblies. By J. J. Forbes, F. E. Griffith, F. E. Cash, and Max S. Petersen. Bureau of Mines, Report of Investigations R. I. 3875. Mimeographed.

Survey of Literature on the Metallurgy of Zirconium. By W. J. Kroll and A. W. Schlechten. Bureau of Mines, Information Circular I. C. 7341. Mimeographed.

Backfilling Problem in the Anthracite Region As It Relates to Conservation of Anthracite and Prevention of Subsidence. By S. H. Ash and James Westfield. Bureau of Mines, Information Circular I. C. 7342. Mimeographed.

Storage of Explosives in Underground Mines of the Lake Superior District. By Frank E. Cash. Bureau of Mines, Information Circular I. C. 7343. Mimeographed.

Inspection Standards for Strip Mines (Coal and Lignite). Revised October 1945. Bureau of Mines, Information Circular I. C. 7350. Mimeographed.

Ground Water in the High Plains of Texas. By W. N. White, W. L. Broadhurst, and J. W. Lang. Geological Survey, Water-Supply Paper 889-F. Price 25 cents.

Quality of Surface Waters of the United States, 1943, With a Summary of Analyses of Streams in Colorado River, Pecos River, and Rio Grande Basins, 1925 to 1943. By C. S. Howard and S. K. Love. Geological Survey, Water-Supply Paper 970. Price 30 cents.

Water Levels and Artesian Pressure in Observation Wells in the United States in 1943. Part 5. Northwestern States. By O. E. Meinzer, L. K. Wenzel, and others. Geological Survey, Water-Supply Paper 990. Price 45 cents.

Iron and Steel. U. S. Tariff Commission. War Changes in Industry Series, Report No. 15. Price 30 cents.

Textile Specifications. Now available are the three parts necessary to give up-to-date record of the government purchase specifications, CCC-T-191a, which include the original specification issued in 1937, the supplement issued October 8, 1945, and the Amendment-2 effective November 29, 1945. The set of three give not only the specifications but a definition of text methods to be used in determining compliance. Price: Specification CCC-T-191a 5 cents; Supplement 10 cents.

Vested Chemical Patents. Office of Alien Property Custodian has issued a second and final supplement giving abstracts of vested chemical patents. The original set of abstracts is $25, and the first and second supplements are $1 each. All orders must be placed with the Office of Alien Property Custodian, Chicago 3, Ill.

Annual Report of the Commissioner of Internal Revenue. Fiscal Year Ended June 30, 1945. Treasury Department Document No. 3135, Internal Revenue. Price 40 cents.

Channels for Trading Abroad. By Corrie Cloyes and Edmund F. Becker. Bureau of Foreign and Domestic Commerce, Economic Series No. 52. Price 10 cents.

Plastic Materials (Basic Information Sources). By Susan M. Phillips. Bureau of Foreign and Domestic Commerce, Inquiry Reference Service. Unnumbered, processed.

Progress in Testing the Relative Effectiveness of New Organic Fungicides in the Control of Plant Diseases. A Summation of Nation-Wide Data in 1945. Prepared by the Fungicide Committee, Potomac Division, The American Phytopathological Society. Order from H. P. Barss, Committee Chairman, Office of Experiment Stations, U. S. D. A., Washington 25, D. C. Unnumbered, mimeographed.

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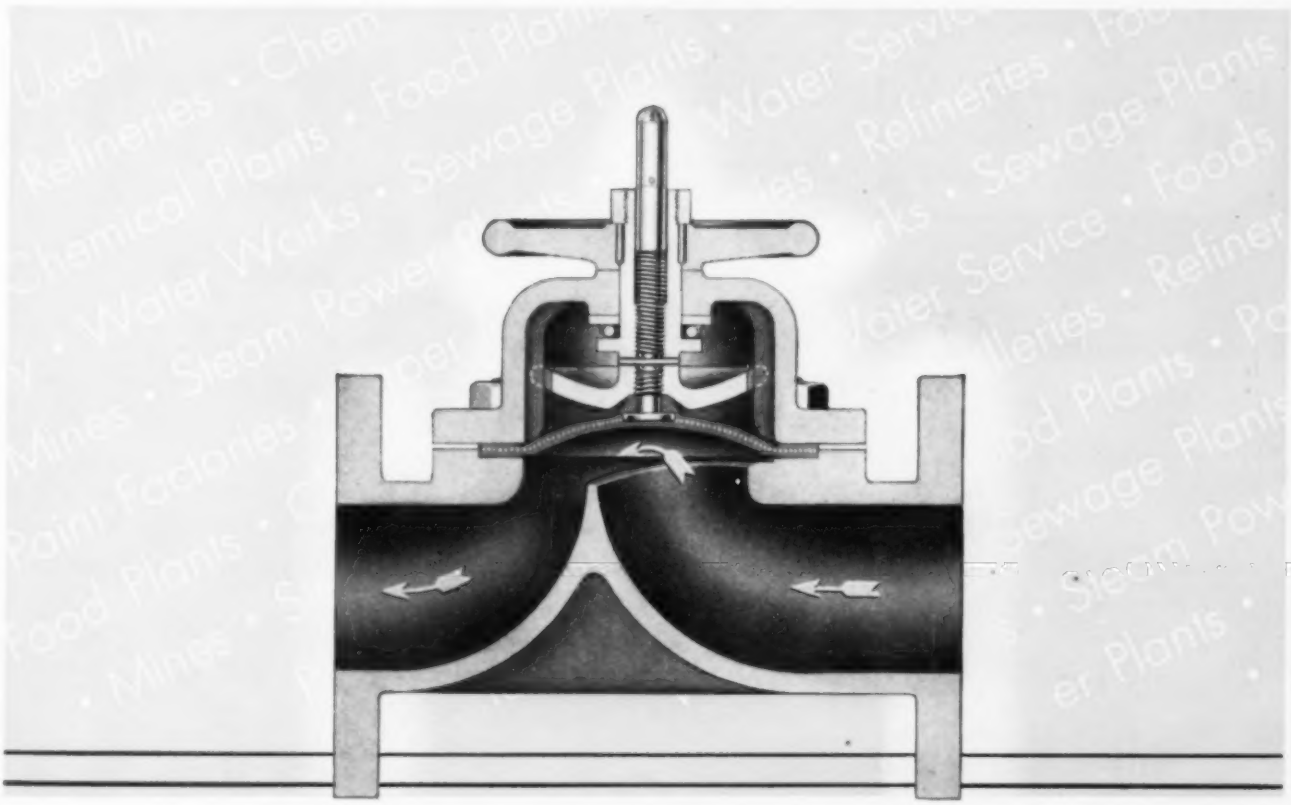

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1

Air Conditioning. Dravo Corp., Pittsburgh, Pa.—4-page bulletin illustrating and describing a new air-cooled conditioning unit for crane cabs working over ingot molds, soaking pits or vats where acid or other fumes are present.

2

Alcohol. Hercules Powder Co., Wilmington, Del.—10-page booklet describing hydroabietyl alcohol derived from rosin. Chemical and physical properties are included.

3

Bearings. Minature Precision Bearings, Keene, N. H.—6-page leaflet illustrating and describing the miniature ball bearings for precision instruments made by this company. Actual sizes of these bearings are shown together with the various dimensions. Tables of specifications are included together with a list of some of the uses.

4

Boiler Control. Northern Equipment Co., Erie, Pa.—Bulletin 447. 16-page illustrated booklet featuring this company's feedwater control systems installed on a large forced circulation boiler. Includes a schematic diagram of the Copes feedwater control system, and illustrations of various component parts of this system.

5

Cathode Ray Tubes. Allen B. Du Mont Laboratories, Inc., Passaic, N. J.—Two catalogs, one dealing with cathode ray tubes and the other with oscillographs for precision measurement.

6

Chemical Products. Pennsylvania Salt Manufacturing Co., Philadelphia, Pa.—Pocket size folded leaflet featuring Kryocide insecticide. Includes a table of application showing the crops protected by this insecticide, the various insects which are destroyed and controlled, together with information on how to use the various different insecticides available. Also a 6-page pocket size leaflet featuring Knox-Out DDT product for household use. A 4-page pocket size leaflet describes the Penco DDT concentrates designed for use by insecticide manufacturers.

7

Classifiers. Hardinge Co., Inc., York, Pa.—2-page leaflet featuring the Hardinge countercurrent classifier. A list of the various Hardinge bulletins covering this company's complete line of equipment is listed.

8

Coatings. Amercoat Div., American Pipe and Construction Co., Los Angeles, Calif.—12-page bulletin discusses difficult corrosion problems in the petroleum industry, and the use of plastic coatings for this work. It summarizes typical applications of these coatings for various petroleum materials.

9

Dielectric Heating. Induction Heating Corporation, New York, N. Y.—4-page leaflet illustrating and describing the Thermonic dielectric generators manufactured by this company. A discussion of dielectric heating is given, and the various models of the Thermonic heaters are shown. Also, a 36-page booklet featuring various applications of induction heating. In addition, 12 data sheets in a loose-leaf binder covering the fundamentals of induction heating and various applications.

10

Electric Controls. Microswitch, Freeport, Ill.—Bulletin No. 36. 16-page booklet describing the use of microswitches in gaging devices and in electrical controls. Construction and operating principles of this equipment are described.

11

Electrical Equipment. Consolidated Diesel Electric Corp., Mt. Vernon, N. Y.—Bulletin CD-101. 4-page leaflet featuring the diesel electric generator sets manufactured by this company.

12

Electrical Equipment. Ideal Industries, Inc., Sycamore, Ill.—2-page leaflet featuring the split bolt connectors for making permanent or temporary solderless connections. List prices are included.

13

Electrical Equipment. Ohmite Mfg. Co., Chicago, Ill.—Bulletin No. 126, 4-page catalog illustrating Riteohm precision resistors made by this company. Capacities, maximum voltages and list prices are given.

14

Equipment. Kennedy Van Saun Mfg. & Eng.

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neering Corp., New York, N. Y.—Bulletin No. 44-A. 80-page booklet illustrating and describing the crushers, conveyors, elevators, screens, classifiers and other similar equipment manufactured by this company. Bulletin No. 44-B. 98-page bulletin describing the application of this company's equipment for pulverized coal and steam generating units. Bulletin No. 44-C. Illustrated booklet features the use of this company's tube mills, ball mills, rod mills, and other equipment for wet or dry grinding or air-sweeping. Bulletin 44-D. 46-page illustrated booklet describing this company's kilns, coolers, dryers, stills, preheaters, soaking pits, deheaters, and heat exchangers.

15

Equipment. The Youngstown Welding & Engineering Co., Youngstown, Ohio—Bulletin R-45. 12-page booklet illustrating and describing the recovering of rolls with nickel, nickel alloys, stainless steel, silicon bronze or other weldable alloys. Industry applications of these rolls are shown. Another booklet now available from this company contains 15 pages and features the facilities, products and services of this company.

16

Extruded Metals. Ampco Metals, Inc., Milwaukee, Wis.—Bulletin No. 141. 2-page leaflet featuring extruded bronze products manufactured by this company.

17

Ferro Clays. Ferro Enamel Corp., Cleveland, Ohio.—6-page leaflet featuring the ferro clays manufactured by this company.

18

Filters. The Blackburn-Smith Mfg. Co., Inc., Hoboken, N. J.—8-page booklet featuring the Refiner, a pressure leaf type filter for clarifying and polishing; this filter is claimed to break tight emulsions and remove oil from condensate down to 0.01 ppm. Principles of operation, design, together with specifications and sizes are given. Other types of cartridge-type filters for industrial, marine, and general service are also illustrated and described.

19

Fire Protection. Pyrene Manufacturing Co., Newark, N. J.—16-page brochure illustrating and describing the uses of air foam for use in fighting liquid fires. Application of air foam to various types of fires is illustrated.

20

Guar. General Mills Inc., Minneapolis, Minn.—16-page booklet entitled "The Story of Guar." Includes data on the production of guar flour and its various uses in industry.

21

Heat Exchangers. The Pfaudler Co., Rochester, N. Y.—Manual No. 837. 32-page manual illustrating and describing heat exchangers and condensers made by this company. Contains several sections on such subjects as applications, design and construction, installation, operation and maintenance, together with an excellent engineering section. Contains an application chart showing the use of heat-exchange equipment for various industries or unit processes, together with a number of schematic application diagrams. Design features, specifications, together with dimensions and capacities are shown for the various types of equipment.

22

Hydrogen. The Girdler Corp., Gas Process Division, Louisville, Ky.—32-page booklet featuring the production of hydrogen. Six commercial methods for producing pure hydrogen are given in detail and flowsheets of each are shown. These include the water gas process, steam-iron process, methanol-steam process, electrolytic process, and the Girdler hydrocarbon-steam "Hygirtol" process. Different methods of hydrogen purification are described, the Girbotol process for separating acidic gases from gases and liquids is discussed and illustrated. A section is devoted to special gases and gas mixtures, and to hydrogen catalysts. Several pages are devoted to the dissemination of other useful information, and includes tables of engineering data, as well as a comprehensive table giving the properties of some 33 gases.

23

Industrial Brushes. Osborn Mfg. Co., Cleveland, Ohio—24-page booklet entitled "How to Select Power Brushes for Manufacturing Operations" contains useful tables to aid in selection of the proper type of brush for various applications.

24

Industrial Locomotives. Vulcan Iron Works, Wilkes-Barre, Pa. Three bulletins, Nos. A-418, A-402, and A-410, featuring industrial diesel-electric locomotives for use in manufacturing plants, mines, mills, etc. Specifications, capacities and performance data are included.

25

Industrial Medicine. American Mutual Liability Insurance Co., Boston, Mass.—8-page folder featuring plans for an industrial medical department. Important details are discussed and

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a floor plan of a proposed medical department is given.

26

Instruments. Askania Regulator Co., Chicago, Ill.—Technical Paper No. 202, 26-page booklet illustrating the process control terms recommended by the Terminology Committee of Industrial Instruments and Regulators Division, ASME. This is a revised edition of a previous booklet covering this same subject.

27

Instruments. Automatic Temperature Control Co., Philadelphia, Pa. Brochure featuring the application of automatic time controls to molding presses. Contains technical articles outlining specific design problems, selection of equipment, electrical circuits and helpful information for anyone concerned with the problem of obtaining better production, better uniformity of products and fewer rejections.

28

Instruments. The Bristol Co., Waterbury, Conn.—Bulletin F 1603. Describes in detail the features of the bellows type differential flowmeter body which requires no mercury. A cross-sectional drawing illustrates the method used to transmit bellows motion to the pen arm. Ranges available are listed. Bulletin No. pH 1302 describes this company's line of pH control instruments. Includes engineering and technical information relative to pH theory and measurement, and describes the various electrode assemblies and accessories offered. Bulletin T 825 features dairy thermometers, including information on temperature sensitive bulbs and fittings of both recording and mercury stem indicating type. Bulletin TA 827 gives specifications and flow diagrams of this company's high-temperature short-time control system. Bulletin T 829 features flow diversion valves and milk flow thermal limit controllers used in the milk industry.

29

Instruments. Davis Emergency Equipment Co., Inc., Newark, N. J.—A circular is now available featuring the Stack-O-Meter for indicating carbon dioxide, stack temperature and draft readings. Specifications and descriptions of the various features are included.

30

Instruments. The Foxboro Co., Foxboro, Mass.—20-page reprint entitled Characteristics of Differential Flow Meters and Factors Affecting Their Operation. Contains illustrations, curves, and tables, together with application diagrams.

31

Instruments. J-B-T Instruments, Inc., New Haven, Conn.—Loose-leaf binder containing several bulletins which illustrate and describe the various types of instruments and testers.

32

Instruments. The C. J. Tagliabue Division, Portable Products Corp., Brooklyn, N. Y.—Catalog No. 699G. 42-page catalog listing the complete line of petroleum product testing equipment manufactured by this company. This includes hydrometers, thermometers, and other special petroleum testing equipment.

33

Insulation. Philip Carey Mfg. Co., Cincinnati, Ohio—A revised edition of this company's heat insulation materials catalog is now available. It covers such insulating materials as magnesia, asbestos, sponge, diatomaceous earth, calcined aggregate, mineral wool, corrugated asbestos types of insulation. Insulating, bonding and refractory cements are also covered. Includes heat loss tables, selection charts and data for determining insulation thickness, and other information. Also a new folder on Careycrete, an industrial asphalt flooring used for surfacing floors and to patch old floors. Includes simple directions for quick patching jobs and describes various applications on new floors.

34

Insulated Pipe Conduit. The Ric-Wil Co., Cleveland, Ohio.—8-page booklet featuring the installation and application of insulated pipe conduit systems in a large industrial plant. Contains diagrammatic sketch of a complete steam distributing system as well as several installation photographs.

35

Filters. Oliver United Filters, Inc., New York, N. Y.—Bulletin No. 213-F. 16-page booklet printed in Spanish, illustrating and describing the filter equipment manufactured by this company. Lists a number of installations in various Central and South American countries.

36

Machine Tools. National Machine Tool Builders Association, Cleveland, Ohio.—24-page booklet entitled "How to Buy Surplus Machine Tools." Includes a list of surplus sales and information offices in this country and answers many questions involved in buying surplus tools.

37

Management Service. Elliott Service Co., New

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York, N. Y.—8-page folder describing the services rendered by this company.

38

Porcelain Enamel. Ferro Enamel Corp., 4150 E. 56th St., Cleveland 5, Ohio—Booklet entitled "Guide and Reference for Color in Porcelain Enamel" which features the oxides and colors manufactured by this company for use in tinting porcelain enamels and plastics. A color chart is also available from this company which illustrates the basic oxides and some of the blends that can be made from base colors.

39

Pumps. Eastern Engineering Co., New Haven, Conn.—20-page pocket size booklet featuring the midget pumps and laboratory stirrers manufactured by this company.

40

Pumps. Peerless Pump Division of Food Machinery Corp., Los Angeles, Calif.—4-page folder illustrating 60 types and styles of vertical and horizontal pumps manufactured by this company. Includes deep and shallow well pumps, high lift pumps, and domestic water systems. Bulletin B-136.

41

Refrigeration. Niagara Blower Co., New York, N. Y.—Bulletin No. 100. Leaflet features the Niagara liquid cooler for accurate temperature control of chilled water or solutions. Operating principles are given and various applications are suggested.

42

Research. Eli Lilly & Co., Indianapolis, Ind. —28-page brochure featuring the B-vitamins. Includes data on the synthesis of these materials and contains a glossary giving names and synonyms of the B-vitamins.

43

Resistors. Clarostat Mfg. Co., Inc., Brooklyn, N. Y.—Catalog No. 46. Lists the resistors, controls and resistance devices manufactured by this company. Includes rheostats, potentiometers, switches, etc.

44

Rustproofing. Nox-Rust Chemical Corp., Chicago, Ill.—24-page catalog illustrating and describing the different rust-proofing compounds and coatings available from this company, together with their principal applications.

45

Safety Equipment. Pulsoman Safety Equipment Corp., Brooklyn, N. Y. 36-page catalog describing Pulsoman respirators, masks, helmets and hoods for protection against dust, fumes, vapors, paint sprays, gases, acids, sandblasting, babbitting, boiler cleaning, etc. Includes general information on how to care for respirators and detailed recommendations on the proper use of this equipment.

46

Seals. Ingersoll-Rand Co., Phillipsburg, N. J. —Bulletin 7100. 16-page bulletin featuring the Shaft-Seal, a mechanical seal for centrifugal pump installations. The design principles and important elements of this new seal are illustrated and described, auxiliary equipment is shown, and special combinations are discussed.

47

Separation Processes. American Cyanamid Co., New York, N. Y.—48-page booklet entitled "Heavy-Media Separation Processes." The development of heavy media separation processes is discussed, its features and advantages listed, its scope and general field of application is given. The process is described in detail and illustrated with several flowsheets and cross-sectional diagrams of various parts of the equipment. Operating results of commercial and pilot plants for various types of ore are given in tabular form. A 26-page section is devoted to the description of a large number of heavy media separation plants used for a wide variety of ores, including zinc, lead, lead-zinc, iron, magnesite, fluorspar, garnet ore. Actual plant descriptions, together with flowsheets, discussion of major problems and results are given.

48

Sifters. Richmond Mfg. Co., Lockport, N. Y. —16-page booklet illustrating and describing the Niagara sifters for use on a wide variety of materials in the process industries. The basic principle of Niagara sifters is described and illustrated. Each of the several models is described briefly and is illustrated with application pictures and cross-sectional diagrams. Capacities, dimensions and specifications are included.

49

Silicone Rubber. Dow Corning Corp., Midland, Mich.—4-page leaflet featuring Silastic, the silicone rubber produced by this company. Various properties are discussed in some detail.

50

Speed Reducers. The Cleveland Worm & Gear Company, Cleveland, Ohio—4-page folder featuring the application of worm gear speed reducers to various types of mixing and grinding equip-

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ment. Contains illustrations featuring installations of worm gear units on equipment used by a number of different industries.

51

Stainless Steel. Allegheny-Ludlum Steel Corp., Pittsburgh, Pa.—Four file size data sheets containing reference data certified by this company and prepared from carefully checked laboratory and service tests. They describe the following stainless steels made by this company: Ludlum 609, a shock resisting steel; Allegheny Metal 18-8C and 18-8T, Types 347 and 321; Allegheny Metal 12-EZ, Type 416, a free machining chromium stainless steel; Allegheny Medal Casting. Contains information on applications, physical properties, mechanical properties, corrosion resistance, heat treatment and other valuable information.

52

Storage Tanks. Chicago Bridge & Iron Co., Chicago, Ill.—12-page booklet entitled "The Horton Floating Roof Used to Reduce Evaporation Loss and Eliminate Fire Hazards in Flat Bottom Tanks Storing Volatile Liquids and Chemicals."

53

Tachometers. Herman H. Sticht Company, Inc., New York, N. Y.—Bulletin No. 1045. 4-page folder illustrating and describing tachometers available from this company.

54

Tar Bases. Koppers Co., Inc., Pittsburgh, Pa.—A new booklet entitled "The Utilization of Tar Bases" is now available from this company.

55

Valves. Cochrane Corp., Philadelphia, Pa.—Bulletin 4150. 28-page booklet illustrating and describing the Cochrane multi-port relief valve. The principle of this multi-port valve is illustrated by pictures and diagrams. Specifications, capacities, dimensions for the different types of valves are included, and sizing data for relief valves is shown in tabular form.

56

Valves. Cooper Alloy Foundry Co., Hillside, N. J.—A new folder announces this company's new procedure of registering stainless steel heat analyses and stamping all castings with corresponding numbers for permanent identification. Various types of stainless steel valves made by this company are featured.

57

Valves. Edward Valve & Mfg. Co., Inc., East Chicago, Ind.—Catalog No. 103. 20-page condensed catalog illustrating and describing the various valves manufactured by this company. Includes illustrations, specifications, pressure ratings, details of design, and the dimensions for the various sized valves available.

58

Valves. Manning, Maxwell & Moore, Inc., Bridgeport, Conn.—Catalog featuring the Weldvalve in gate, globe and angle designs for 600-lb. to 2500-lb. pressures. The features of this new Weldvalve include the elimination of valve joints, seat ring joints, bonnet joints.

59

Valves. Merco Nordstrom Valve Co., Pittsburgh, Pa.—Catalog No. 9. 192-page catalog illustrating and describing the complete line of valves and accessories available from this company. Contains information on the basic principles of the Nordstrom lubricated valves and includes specifications, dimensions, list prices and detail drawings of the various valves and accessories. A large number of valve lubricants are listed, together with their temperature range, properties, principal services, available forms, and the services for which they are not suited. Also contains a 25-page section on engineering data and tables. Bulletin V-126-REV.1 is a 24-page booklet giving instructions for the lubrication and maintenance of Nordstrom valves. Bulletin V-105. REV. 6 is a 36-page booklet describing the lubricants available for Nordstrom valves. Includes a 20-page section on the service recommendations for these lubricants.

60

Water Strainer. S. P. Kinney Engineers, Inc., Pittsburgh, Pa.—4-page circular featuring the Brassert self-cleaning water strainer in 3-in. to 30-in. pipe sizes. Available in capacities up to 3,000,000 gal. of water per min. This equipment is illustrated and described, and includes capacities, straining media, and other engineering data.

61

Water Treating. Water Service Laboratories, New York, N. Y.—4-page leaflet featuring the boiler cleaning service of this company for internal cleaning of heating boilers.

62

Wire Cloth. Multi-Metal Wire Cloth Co., Inc., New York, N. Y.—New 1946 catalog showing this company's developments in wire cloth as applied to filtration, sifting, cleaning and other processes.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDUSTRIAL CONSUMPTION OF CHEMICALS REACHED ALL-TIME HIGH IN MARCH

ALTHOUGH NOT free from labor disturbances, domestic production in general continued to move ahead in March and the index of the Federal Reserve Board jumped from a revised figure of 149 for February to 165 for March. This put the March rate at a little better than the average for the final quarter of last year. This position was fairly well maintained throughout the first half of April when the labor situation began to bring appreciable drops in general productive activity. With conditions becoming still worse in the early part of May, the outlook was dubious for realizing any worthwhile gains in the second quarter.

The Civilian Production Administration reported that in March, industry made the largest gains since V-J Day with consumer income higher than at any time since the war. Employment figures also were up sharply for the month with construction, automobiles, tires, and a long list of civilian products listed as responsible for the record breaking output of civilian goods and services which was at a rate of $154,000,000,000 annually.

Industrial consumption of chemicals in March responded to the acceleration of general production and reached an all-time monthly high. The *Chem. & Met.* index for March is 206.12 compared with a revised figure of 176.56 for February. Last year the indexes were 191.09 and 175.70 respectively. The first quarter showing this year is the best in the history of the industry. The rise over the comparable period of 1945 is due principally to greater activity in fertilizer manufacture and to the larger volumes of rubber and plastics made available for civilian goods. The glass industry also has operated on a high level with plate glass output especially far outstripping anything reported since the start of the war. The loss in steel production likewise has held down production of tin cans and prolonged the period when glass containers must bear more than a proportionate part of packaging demands. Production of glass containers for 1946 is estimated at from 110 million to 120 million gross with consuming demand running considerably above the higher figure.

Second quarter prospects for chemicals were lessened by the long-continued coal strike which not only adversely affected actual production of certain chemicals but also reduced consuming outlets by slowing operations at manufacturing plants which use chemicals as raw materials. Outputs of basic coal-tar chemicals have gone down as coke plants reduced operations and the smaller volume of raw materials cut production of intermediates and finished coal-tar products. Other chemical plants were affected by the shortage of fuel and the chemical industry as a whole undoubtedly recorded a drop in output in April and the early part of May.

One of the developments which may prove of long-time benefit was the establishing of higher prices for wood pulp. To this may be ascribed part of the rising trend reported for paper and pulp production in March which reached new postwar highs. The combined outputs of paper and paperboard in March exceeded any previous monthly total since 1942. Another outcome, and not so favorable, is found in the change in plans for expansion of chemical productive facilities. In 1945, plans were completed for erecting new plants and expanding old ones with much of the work to get under way early this year. Strikes, which have cut back supplies of necessary materials, and the general rise in labor costs have brought about new appraisals and these combined with government regulations surrounding new building have definitely postponed the carrying out of proposed expansion plans.

Industries which make use of oils and fats as raw materials are still handicapped by the paucity of offerings. Apparently there is no hope for nearby relief and the situation later in the year will be dependent on the outcome of the harvest of oil-bearing crops. Currently the outlook is described as about the same as last year which means that domestic supplies of oils and fats for the year will amount to approximately 9.5 million pounds and the most favorable condition is reported for animal fats with the oil supply expected to run far short of requirements.

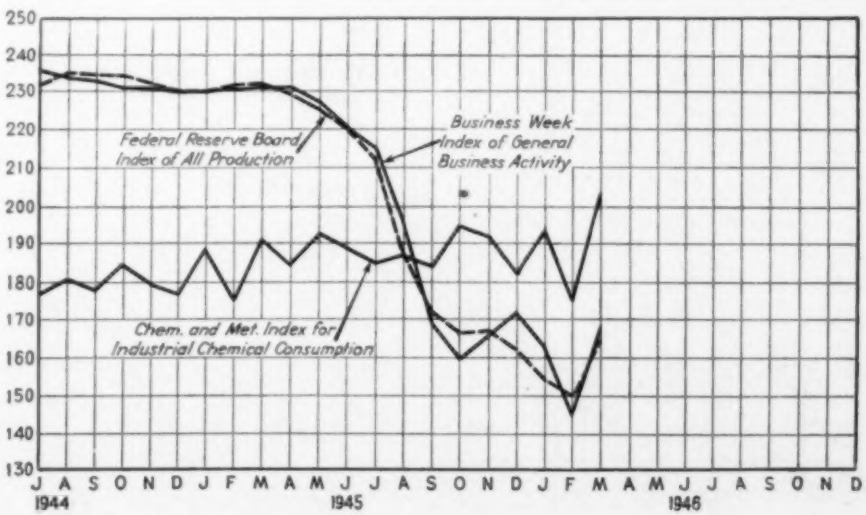
Soap makers, in particular, are feeling the shortage of oils and fats with soap deliveries for the first quarter of this year continued on a declining scale running more than 5 percent below the total reported for the final quarter of last year and more than 23 percent below the total delivered in the first quarter of last year. From a chemical standpoint, the drop in soap production was less drastic as sales of liquid soap made a better showing and soap powders also have been produced in a large way.

Production of silver salts which are essential in many industries, has been held in check because supplies of the metal are not readily available. There is plenty of silver in the country and some time ago legislation was introduced in Congress to permit the government to sell silver at 71c. an ounce. Political pressure from those desiring higher prices for silver blocked this legislation and compromise measures with a sharp marking up in price are now in the making. In the meantime foreign sellers are holding back on the prospects of getting more for their stocks in the future and domestic consumers find it difficult to buy at any price.

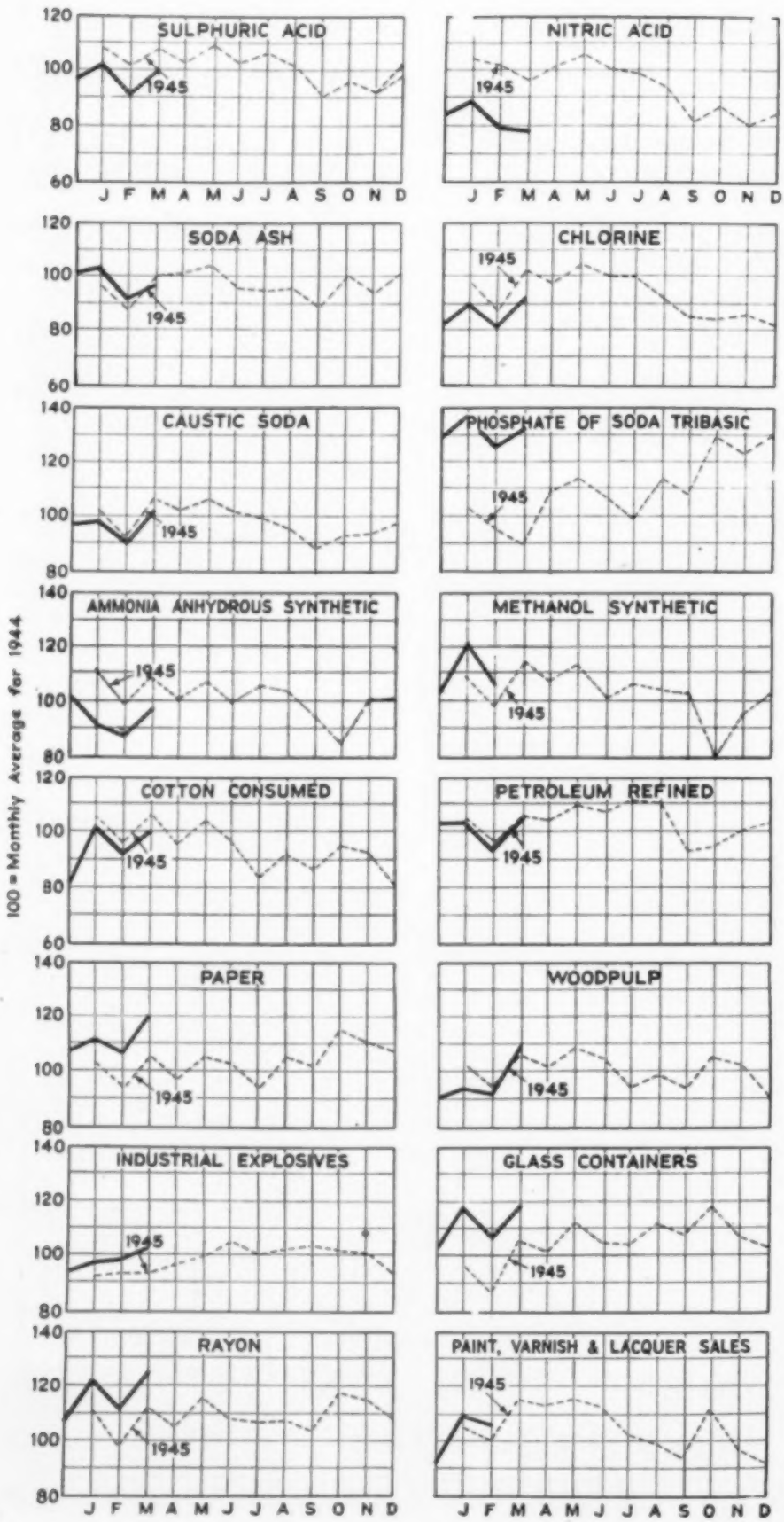
***Chem. & Met.* Index for Industrial Consumption of Chemicals**

1935 = 100

	Feb. Revised	March
Fertilizers	44.05	44.97
Pulp and paper	19.73	22.49
Petroleum refining	16.86	18.88
Glass	20.58	21.90
Paint and varnish	17.73	21.67
Iron and steel	2.02	11.67
Rayon	18.74	20.93
Textiles	10.25	11.29
Coal products	3.77	8.70
Leather	4.60	4.75
Industrial explosives	5.29	5.58
Rubber	6.85	6.95
Plastics	6.09	6.35
	176.56	206.12



PRODUCTION AND CONSUMPTION TRENDS



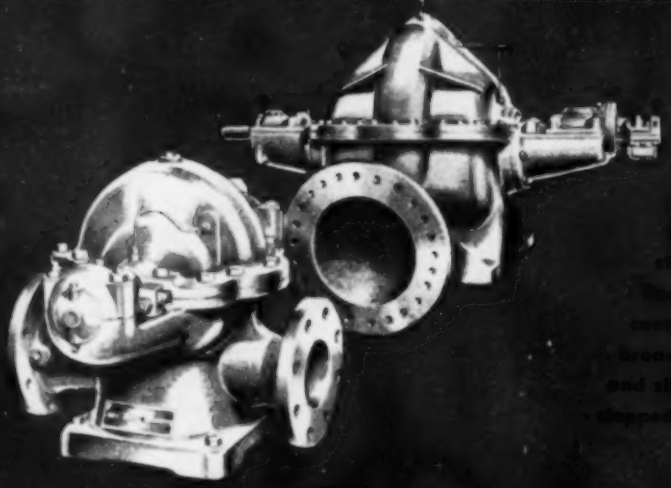
PRODUCTION of the heavier tonnage chemicals generally showed a marked gain in March over the February totals but there were a few exceptions as smaller outputs were reported for synthetic anhydrous ammonia dibasic calcium phosphate, hydrofluoric acid, nitric acid, silver nitrate, and sodium silicate. The trend for industrial chemical production in general has been upward since the first of the year as measured by the production indexes of the Federal Reserve Board which stood at 388 in January, 389 in February, and 399 in March. The average for the quarter is 392 which compares with a little more than 399 for the corresponding period of 1945.

The moderate decline from wartime highs which features current chemical production illustrates the extent to which civilian requirements have risen to compensate for the loss in military orders. In many cases there still is a shortage of chemicals and many consuming industries have not attained full productive possibilities because of work stoppages or other outside influences. It is evident, therefore, that given favorable conditions, the trend of chemical production will be upward at least until the backlog of consumer needs for a wide range of finished products has been satisfied. Experience gained in the postwar months gives support to the belief that the settlement of economic problems will establish the chemical industry, both production and consumption, on a level at least equal to the highest attained in the war years.

The cotton branch of textile manufacture is slow to regain its wartime peak but long range views are favorable for an unusually large annual consumption of cotton. Arrivals of silk, while still relatively small, have given greater prominence to that branch. Consumption of wool has been gaining with carpet wools in much better demand. Rayon shipments to mills will create a new record this year. Hence from a fiber standpoint, the textile industry is in a position to forge ahead.

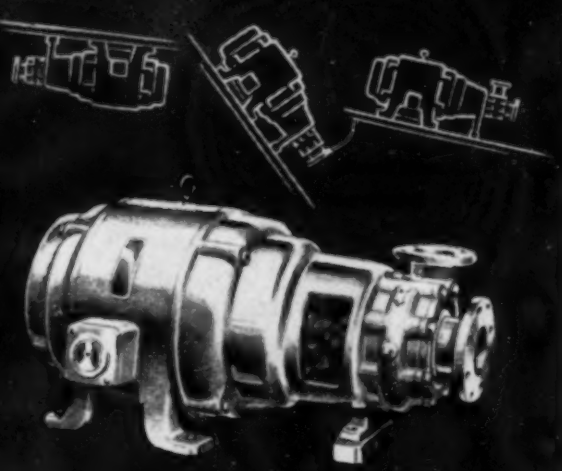
Paint manufacturers still are forced to vary their formulas according to the availability of raw materials. Shortages are found in the different branches of manufacture, running from pigments and colors to the important drying oils. In some ways these shortages have changed the customary proportions of finished products turned out. For instance some manufacturers, unable to maintain the quality of their branded outside paints, have concentrated more on making interior finishes where their selection of raw materials is less restricted.

Growth in the variety and total volume of plastics outputs has been a factor in broadening consumption of many chemicals. Currently, production of plastics is prescribed by shortages in component chemicals. Furthermore the intention of plastics producers to expand facilities has been publicized and if plans to expand production by 300,000,000 lb. by the middle of next year are even approximated it becomes evident that much larger supplies of a varied line of chemicals must be made available.



Time to Forget . . . and Remember!

Now is the time to forget your old pumps whose efficiency is that of a bygone era and whose daily services are costing you money! Remember—pumps are commonly designed and built to answer specific conditions of head and capacity: When these conditions change, the increase in pumping costs may be appreciable.



Name your pumping job—there's a modern Fairbanks-Morse "high-efficiency" pump ready to handle it. For instance, the line of vertical Angle-Flow pumps for moving lots of water—up to 40,000 g.p.m.—at a cost that, even compared with modern standards, is strangely low.

FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES · DIESEL ENGINES · MAGNETOS · GENERATORS · MOTORS · PUMPS
SCALES · STOKERS · RAILROAD MOTOR CARS and STANDPIPES · FARM EQUIPMENT

END USES FOR CHEMICALS

Formaldehyde, 1000 lb., 37 percent

Use	Amount	Per-cent
Total Consumption	485,292	100.0
Direct Military[1]	1,331	0.3
Foreign	7,523	1.5
Other uses	476,437	98.2
Resins, total	243,375	50.3
Phenolic	137,942	28.4
Urea and melamine	101,048	21.0
Other resins[2]	4,385	0.9
Chemical, total	199,409	41.0
Hexamethylenetetramine	64,407	13.3
Pentaerythritol	55,367	11.4
Rubber chemicals	2,537	0.5
Other chemicals[3]	77,098	15.8
Other uses	33,653	6.9
Textiles	7,998	1.7
Dyes and intermediates	3,498	0.7
Leather	2,640	0.5
Embalming fluid	1,148	0.2
Drugs and pharmaceuticals[4]	804	0.2
Paper	624	0.1
Adhesives and protective coatings	592	0.1
Disinfectants and insecticides[5]	492	0.1
Photography	465	0.1
Miscellaneous uses and small orders[6]	15,892	3.2

[1] Data not available. [2] Includes that used in synthetic resins. [3] Includes amount used for manufacture of ethylene glycol, paraformaldehyde, hydroxyacetic acid, citric acid, chlorine, methoxy-methoxy-ethanol and methyl hydroxyacetate. [4] Roughly half this quality was used for processing penicillin. [5] Includes germicides and fungicides. [6] Used in manufacture of theobromine, explosives, boiler-water treating compounds, metal treating agents.

Phenol, 1000 lb.

Use	Amount	Per-cent
Total Allocations	205,186	100.0
Direct military[1]	20,702	10.1
Foreign	23,307	11.3
Other uses	161,177	78.6
Phenolic resins	106,655	52.0
Chemical manufacture[2]	11,806	5.7
Salicylates	11,264	5.6
Petroleum refining[3]	10,857	5.2
Disinfectants and insecticides[4]	5,707	2.8
Triphenyl phosphate and other plasticizers	4,585	2.2
Toluene extraction	4,262	2.1
Dyes and inks	2,187	1.1
Medicinals, other than salicylates	1,783	0.8
Miscellaneous uses and small orders	2,121	1.1

[1] Data not available. [2] Includes substituted phenols. [3] Oil additives and oil refining materials. [4] Chlorinated phenols.

Aniline 1,000 lb.

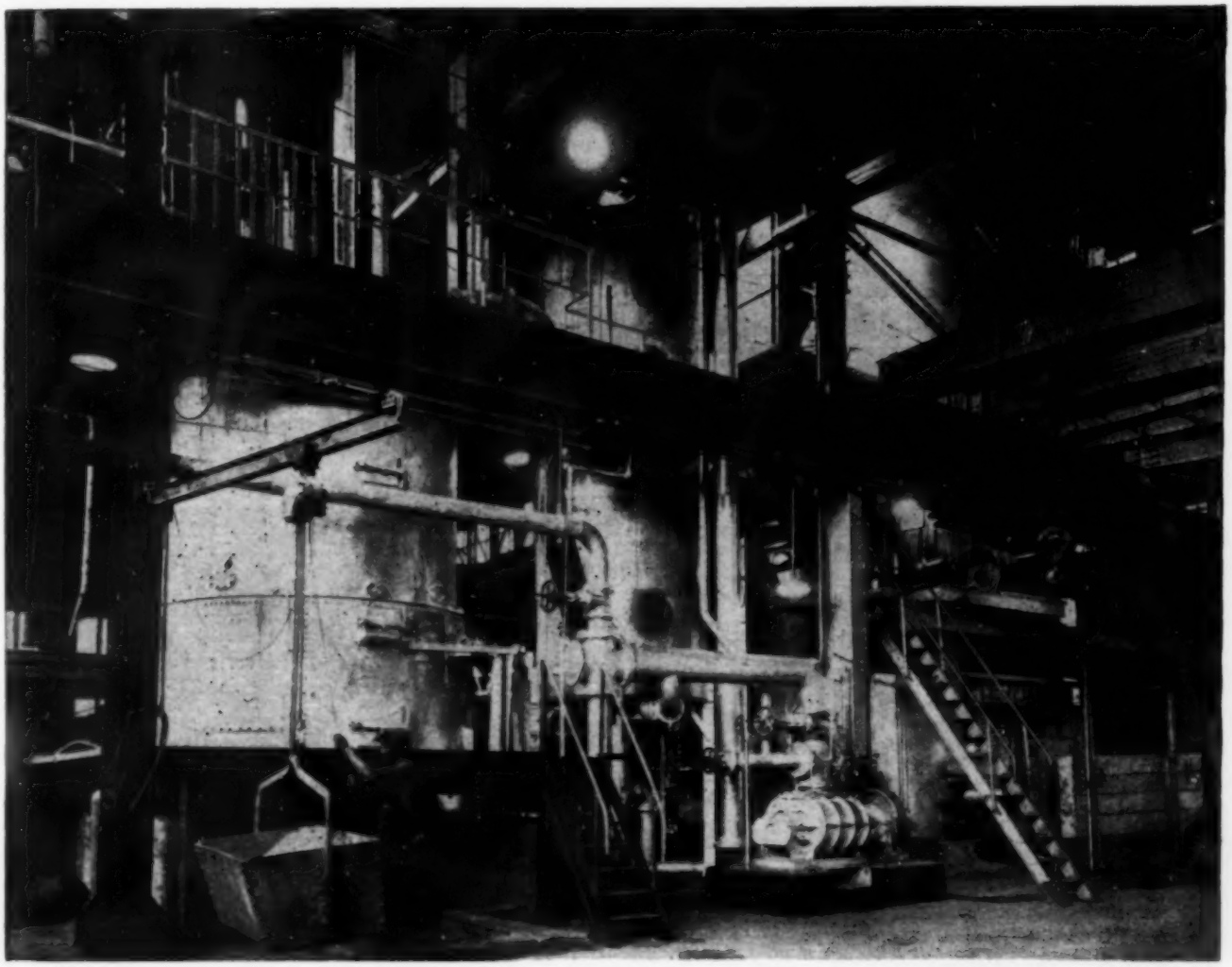
Use	Amount	Per-cent
Total Consumption	89,785	100.0
Direct military[1]	5,546	6.2
Foreign	1,696	1.9
Other uses	82,543	91.9
Rubber chemicals[2]	46,137	51.4
Dyestuffs, pigments, intermediates	19,350	21.5
Drugs and pharmaceuticals[3]	3,808	4.2
Explosives and stabilizers	3,030	3.4
Photographic chemicals	1,935	2.2
Petroleum refining[4]	1,572	1.8
Resins and plastics	1,553	1.7
Miscellaneous uses and small orders[5]	5,158	5.7

[1] Data not available. [2] Synthetic rubber additives such as cyclohexylamine, diphenylamine and hydroquinone. [3] Largely for manufacture of sulfa drugs. [4] Preparation of emulsion breakers, petroleum additives, gasoline gum inhibitors, and oil corrosion inhibitors. [5] Flotation products, paraciticides, mildew inhibitors, etc.

Naphthalene 1,000 lb.

Use	Amount	Per-cent
Total Allocations	259,851	100.0
Phthalic anhydride	170,262	65.5
Other intermediates[1]	53,030	20.4
Moth repellants and insecticides[2]	22,339	8.6
All other uses[3]	14,220	5.5

[1] Manufacture of beta-naphthol, chlorinated naphthalene and other intermediates. [2] Manufacture agriculture insecticides. [3] Oil additives and oil treating agents, chemical manufacturers.



This WELLMAN-GALUSHA CLEAN GAS GENERATOR

has been operating 24 hours a day, 7 days a week, since 1929

WELLMAN Will Build It!

- Car Dumpers
- Gas Producer Plants
- Gas Flue-Systems
- Gas Reversing Valves
- Coke Pushers
- Mine Hoists
- Skip Hoists
- Ore Bridges
- Clamshell Buckets

STILL GOING STRONG after seventeen years of service—that's a typical performance record for this famous Generator! Wellman-Galusha Generators supply low-cost fuel for heating and heat-treating furnaces in steel and non-ferrous metal industries—glass melting and annealing, kilns and furnaces for the ceramic industry—also used where chemical processes require gas of unusual composition for reduction of oxides and for synthesis of various chemical products, and for gas engines, stationary or marine.

THE WELLMAN ENGINEERING COMPANY
7032 CENTRAL AVENUE • CLEVELAND 4, OHIO

United States Production of Certain Chemicals

February 1946, February 1945 and Two-Month Totals for 1946 and 1945

Chemical and Basis	Units	February 1946	February 1945	Total, First Two Months 1946	Total, First Two Months 1945
Ammonia, synthetic anhydrous[1]	Tons	39,738	44,756	81,122	94,619
Ammonium nitrate (100% NH_4NO_3)	Tons	38,543	.....	76,238	.....
Ammonium sulphate, synthetic (technical)	M lb.	17,855	.....	35,851	.....
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	1,104	.....	2,056	.....
Calcium carbide (commercial)	Tons	40,316	56,729	85,508	118,488
Calcium phosphate:					
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	6,332	5,312	11,901	10,028
Dibasic (100% $CaHPO_4$)	M lb.	8,083	3,383	15,833	7,102
Carbon dioxide:					
Liquid and gas	M lb.	18,630	16,406	33,397	32,848
Solid (dry ice)	M lb.	38,539	42,018	76,850	83,292
Chlorine	Tons	84,798	92,066	174,505	196,019
Chrome green (C.P.)	M lb.	.....	546	.....	1,192
Chrome yellow and orange (C.P.)	M lb.	4,140	2,978	8,737	6,334
Hydrochloric acid (100% HCl)	Tons	26,837	33,671	53,659	68,826
Hydrofluoric acid	M lb.	3,063	.....	5,267	.....
Hydrogen	M cu. ft.	1,307,000	1,944,000	2,833,000	4,015,000
Lead arsenate (acid and basic)	M lb.	7,567	7,570	13,988	.....
Molybdate chrome orange (C.P.)	M lb.	.....	100	.....	237
Nitric acid (100% HNO_3)	Tons	31,121	40,067	65,890	80,943
Oxygen	M cu. ft.	605,693	1,345,789	1,321,436	2,639,731
Phosphoric acid (50% H_3PO_4)	Tons	69,728	51,328	138,180	102,592
Soda ash (Commercial sodium carbonate):					
Ammonia soda process (98–100% Na_2CO_3):					
Total wet and dry[2]	Tons	342,625	331,952	729,637	697,670
Finished light[2]	Tons	168,213	171,929	365,705	357,445
Finished dense	Tons	123,046	107,795	255,385	232,743
Natural[4]	Tons	16,548	13,569	34,193	28,037
Sodium bicarbonate (refined) (100% $NaHCO_3$)	Tons	13,809	11,552	38,941	24,166
Sodium bichromate and chromate	Tons	7,134	6,409	14,869	12,991
Sodium hydroxide (100% NaOH):[5]					
Electrolytic process:					
Liquid	Tons	81,499	88,216	167,421	185,956
Solid	Tons	14,713	18,120	32,470	37,581
Lime soda process:					
Liquid	Tons	61,646	58,039	130,073	121,329
Solid	Tons	17,861	19,397	40,479	39,257
Sodium phosphate:					
Monobasic (100% NaH_2PO_4)	Tons	1,116	874	2,360	1,975
Dibasic (100% Na_2HPO_4)	Tons	5,262	4,541	10,989	8,631
Tribasic (100% Na_3PO_4)	Tons	8,429	6,456	17,645	13,331
Meta (100% $NaPO_3$)	Tons	2,647	1,977	4,919	3,911
Tetra (100% $Na_4P_2O_7$)	Tons	5,125	3,059	9,468	5,929
Sodium silicate (anhydrous)	Tons	32,851	33,575	67,375	71,972
Sodium sulphate:					
Anhydrous (refined) (100% Na_2SO_4)	Tons	7,001	.....	15,865	.....
Glauber's salt and crude salt cake	Tons	55,836	.....	109,411	.....
Sulphuric acid (100% H_2SO_4):[7]					
Chamber process	Tons	235,867	277,842	474,076	573,782
Net, contact process[6]	Tons	389,117	449,518	822,437	926,983
Zinc yellow (zinc chromate) (C.P.)	Tons	.....	1,347	.....	2,778

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary productions and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Includes oleum grades. Excludes spent acid. [7] Data for sulphuric acid manufactured as a byproduct of smelting operations are no longer included. This production by eight plants accounted for approximately four percent of the 1945 total production.

United States Production of Certain Synthetic Organic Chemicals

January 1946, January 1945, and Twelve Month Totals for 1945

Chemical	January 1946	January 1945	Total 1945[6]
Acetanilid, technical and U.S.P.	682,255	.....	6,951,294
Acetic acid:			
Synthetic[1]	19,543,529	26,314,624	261,024,369
Recovered	62,640,513	.....	1,008,914,108
Natural[3,4]	1,897,533	3,211,541	31,645,086
Acetic anhydride[5]	45,733,425	44,833,295	526,264,258
Acetone	25,846,431	.....	351,422,643
Aniline	7,070,695	.....	88,493,006

(continued on page 326)

For Pressure-tight Circuits

PARKER

VALVES AND COUPLINGS

For fewer leaks, for lower pressure drop, specify Parker Valves and Couplings. They're specially designed to simplify hydraulic power and fluid transmission tubing systems.

Parker Valves are light, yet strong. They'll give you smoother flow. And PARKER TRIPLE COUPLINGS complete the circuit with leakproof, vibration-protected joints. You'll have a system that's easier to install, safer to operate and quicker to service.

Stocks of industrial valves, couplings and fittings are now available at your distributor's and at Parker warehouses. Send for our catalogs. The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio. In Canada, Railway & Power Engineering Corporation, Ltd., Montreal, P. Q.

Look for this famous trade mark. It's your assurance of trouble-free couplings and valves. These initials, ALP, are the initials of our founder, A. L. Parker. Let them serve to remind you that for Alignment, Leak-protection and Pressure-tightness you can't beat Parker Valves and Couplings . . . the couplings with the famous patented Parker Triple construction.

THE PARKER APPLIANCE CO.

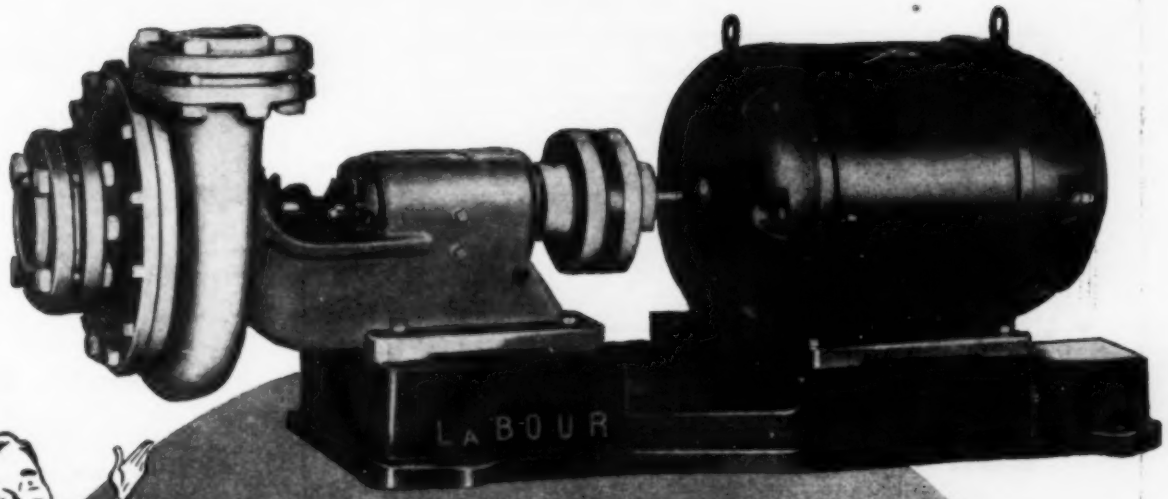
CLEVELAND • LOS ANGELES

FLUID POWER PRODUCTS FOR ALL INDUSTRY

U.S. Production of Synthetic Organic Chemicals (Cont. from p. 324)

Chemical	January 1946	January 1945	Total 1945 [11]
Acetylsalicylic acid	986,368	886,502	10,860,346
Barbituric acid derivatives:[2]			
5-Ethyl-5-phenylbarbituric acid and salts (phenobarbital)	29,048	20,309	276,763
Benzene:			
Motor grade:			
Tar distillers[4]	1,064,619	.....	3,978,333
Coke-oven operators[5]	.....	.....	28,175,199
All other grades:			
Tar distillers[4]	1,525,514	.....	31,956,745
Coke-oven operators[5]	.....	.....	127,056,339
Butyl alcohol, primary, normal	9,388,995	.....	129,275,394
Carbon bisulphide	26,204,998	.....	329,844,695
Carbon tetrachloride	11,642,663	.....	190,053,616
Chlorobenzene, mono	21,986,491	.....	234,763,921
Creosote oil:			
Tar distillers	9,815,219	9,531,624	127,277,483
Coke-oven operators	.....	3,041,278	35,342,391
Cresols:[7]			
Meta-para	273,659	666,188	7,833,171
Ortho-meta-para	495,181	735,034	9,708,509
Cresylic acid, refined[7]	1,539,531	2,675,625	29,244,088
Dibutyl phthalate	.....	.....	41,838,451
Dichlorodiphenyltrichloroethane (DDT)	3,489,588	.....	32,998,587
Ethyl acetate (85%)	6,420,602	9,027,451	103,654,106
Ethyl ether, technical and U.S.P.	3,313,097	7,621,243	75,580,610
Formaldehyde (37% by weight)	39,210,905	.....	477,822,274
Methanol:			
Natural	1,402,481	[9]1,686,560	18,686,726
Synthetic	48,054,166	42,861,200	491,459,699
Naphthalene:			
Tar distillers (less than 79° C.)[4]	16,035,667	15,387,355	205,923,008
Tar distillers (79° C. and over)[4]	8,319,874	5,380,973	77,229,365
Coke-oven operators (less than 79° C.)[5]	.....	7,358,866	87,573,464
Penicillin[5]	1,513,005	.....	.....
Phenol (synthetic and natural)[7]	15,815,121	.....	204,815,380
Phthalic anhydride	8,703,071	10,319,502	123,301,944
Styrene (government owned plants only)	27,060,428	.....	375,118,886
Sulfa drugs[5]	435,600	377,280	5,912,107
Toluene:			
Coke-oven operators[6]	.....	.....	27,588,053
All other[4] [10]	1,131,192	.....	122,453,532

All data in pounds except benzene (gal.), creosote oil (gal.), toluene (gal.), and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1] Excludes the statistics on recovered acid. [2] Acid produced by direct process from wood and from calcium acetate. [3] All acetic anhydride including that from acetic acid by vapor-phase process. [4] Product of distillers who use purchased coal tar only or from oil-gas or water-gas tar produced or purchased by tar distillers. [5] Statistics are given in terms of bulk medicinals only. [6] Statistics collected by the Bureau of Mines. [7] Total production including data reported both by coke-oven operators to Bureau of Mines and by distillers of purchased coal tar to the U. S. Tariff Commission. [8] Reported to U. S. Bureau of the Census. [9] Reported in gal. by Bureau of the Census but converted to lb. for comparison with the production of synthetic methanol. [10] Includes toluene produced from petroleum by any process. [11] Revised.



Well, yes and no...

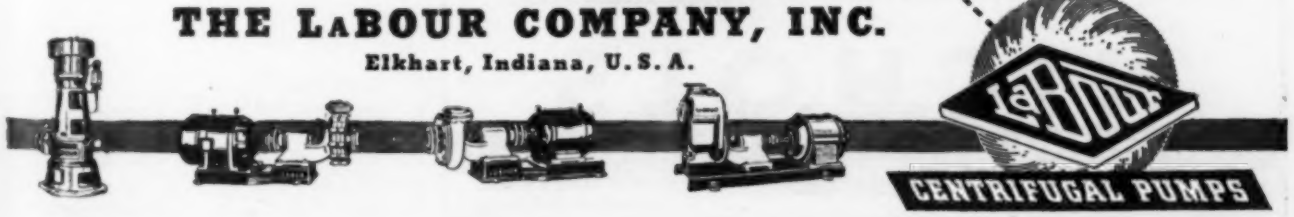
Strictly speaking, LaBour Type Q is classed as a non-priming centrifugal pump. Yet under certain conditions it will prime itself. That's an important fact in many process plant applications.

To be classed as self-priming, a pump must be able to handle 100% air or vapor under high suction lift. LaBour Types G and D will do this. LaBour Type Q, however, can handle about 20% air or vapor mixed with liquid for a protracted time, and it can take and dispose of brief 100% gulps, thus priming itself completely under some low suction lift conditions.

The result is a highly efficient, "non-priming" centrifugal pump which has high air handling ability under many conditions. Type Q, like the rest of the LaBour family of pumps, is repeated proof of a long-established fact — if you need a LaBour, nothing else will do.

IF YOU NEED A
LABOUR
NOTHING ELSE WILL DO

THE LABOUR COMPANY, INC.
Elkhart, Indiana, U. S. A.



LaBOUR
CENTRIFUGAL PUMPS

CHEM. & MET

Weighted Index of Prices for

CHEMICALS

Base = 100 for 1937

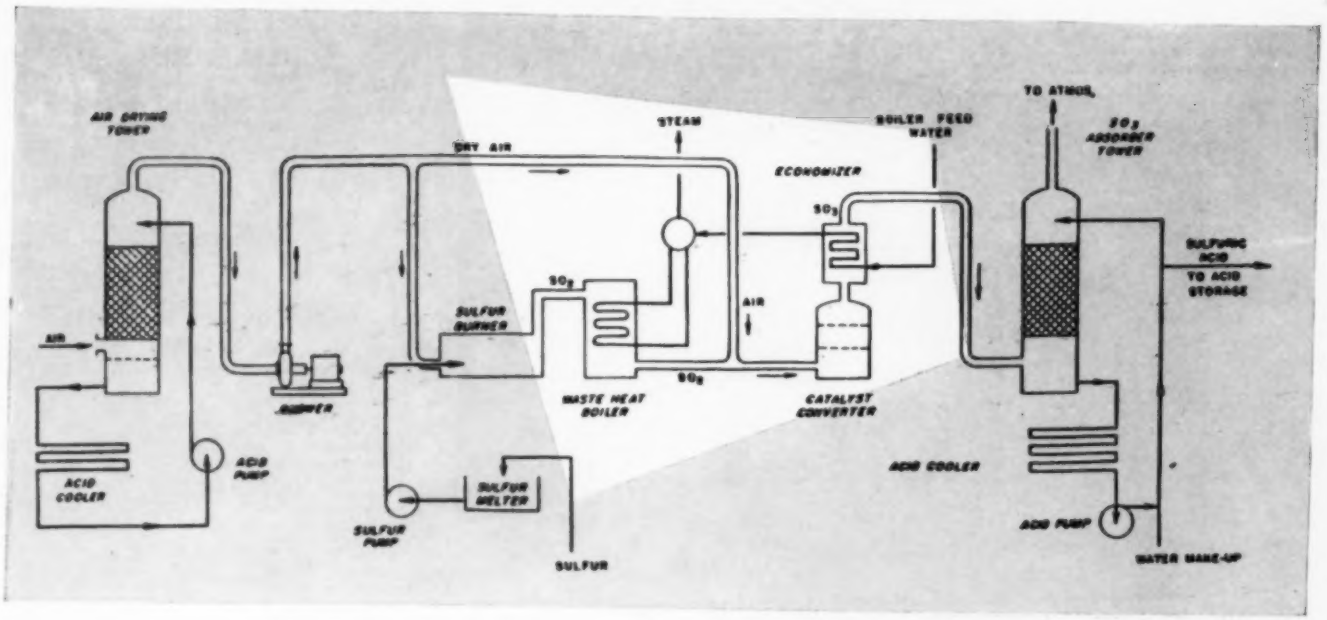
This month	**109.13**
Last month	109.13
May, 1945	108.97
May, 1944	109.49

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to May 13.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb	$0.06 –
Acid, acetic, 28% bbl., 100 lb	3.38 – $3.63
Boric, bbl., ton	109.00 – 113.00
Citric, kegs, lb	.20 – .23
Formic, cbys, lb	.10½– .11
Hydrofluoric, 30%, drums, lb	.08 – .085
Lactic, 44% tech., light, bbl., lb	.073– .075
Muriatic, 18°, tanks, 100 lb	1.05 –
Nitric, 36°, carboys, lb	.05 – .05½
Oxalic, crystals, bbl., lb	.11½– .12½
Phosphoric tech., tanks, lb	.04 –
Sulphuric, 60°, tanks, ton	13.00 –
Tartaric, powd., bbl., lb	.62 – .65
Alcohol, amyl from pentane, tanks, lb	.131 –
Alcohol, butyl, tanks, lb	.10½– .22
Alcohol, ethyl, denatured, No. 1 special, tanks, gal	.542 –
Alum, ammonia, lump, lb	.04½–
Aluminum sulphate, com. bags 100 lb	1.15 – 1.45
Ammonia, anhydrous, cyl., lb	.14½–
tanks, ton	50.00 – 60.00
Ammonium carbonate, powd., casks, lb	.09½– .10
Sulphate, wks., ton	28.20 –
Amyl acetate, tech. from pentane, tanks, lb	1.45–
Aqua ammonia, 26°, drums, lb	.02½– .03
tanks, ton	65.00 –
Arsenic, white, powd., bbl., lb	.04 – .04½
Barium carbonate, bbl., ton	65.00 – 75.00
Chloride, bbl., ton	75.00 – 78.00
Nitrate, casks, lb	.09½– .11
Blanc fix, dry, bags, ton	60.00 – 70.00
Bleaching powder, f.o.b., wks., drums, 100 lb	2.50 – 3.00
Borax, gran., bags, 100 lb	45.00 –
Calcium acetate, bags, 100 lb	3.00 –
Arsenate, dr., lb	.07½– .08
Carbide, drums, ton	50.00 –
Chloride, flake, bags, del., ton	18.50 – 25.00
Carbon bisulphide, drums, lb	.05 – .05½
Tetrachloride, drums, gal	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb	1.75 – 2.00
Copperas, bgs., f.o.b., wks., ton	17.00 – 18.00
Copper carbonate, bbl., lb	.19½– .20
Sulphate, bbl., 100 lb	5.00 – 5.50
Cream of tartar, bbl., lb	.50 – .52
Diethylene glycol, dr., lb	.14½– .15½
Epsom salt, dom., tech., bbl., 100 lb	1.80 – 2.00
Ethyl acetate, tanks, lb	.09½– .11½
Formaldehyde, 40%, tanks, lb. wks.	.032–
Furfural, tanks, lb	.09½–
Glaubers salt, bags, 100 lb	1.05 – 1.10
Glycerine, c.p., drums, extra, lb	.18½– .19
Lead:	
White, basic carbonate, dry, casks, lb	.08½–
Red, dry, sck., lb	.09½–
Lead acetate, white crys., bbl., lb	.12 – .13
Arsenate, powd, bag., lb	.11½– .12
Lithopone, bags, lb	.04½– .04½
Magnesium carb., tech., bags, lb	.07½– .08
Methanol, 95%, tanks, gal	.60 –
Synthetic, tanks, gal	.24 –
Phosphorus, yellow, cases, lb	.23 – .25
Potassium bichromate, casks, lb	.10½– .10½
Chlorate, pwd., lb	.09½– .12
Hydroxide (c'stic potash) dr., lb	.07 – .07½
Muriate, 60%, bags, unit	.53½–
Nitrate, ref., bbl., lb	.08 – .09
Permanganate, drums, lb	.19½– .20
Prussiate, yellow, casks, lb	.16 – .17
Sal ammoniac, white, casks, lb	.05½– .06
Salsoda, bbl., 100 lb	1.00 – 1.05
Salt cake, bulk, ton	15.00 –
Soda ash, light, 58%, bags, contract, 100 lb	1.05 –
Dense, bags, 100 lb	1.15 –
Soda, caustic, 76% solid, drums, 100 lb	2.30 – 3.00
Acetate, del., bbl., lb	.05½– .06
Bicarbonate, bbl., 100 lb	1.70 – 2.00
Bichromate, bags, lb	.07½– .08
Bisulphate, bulk, ton	16.00 – 17.00
Bisulphite, bbl., lb	.03 – .04



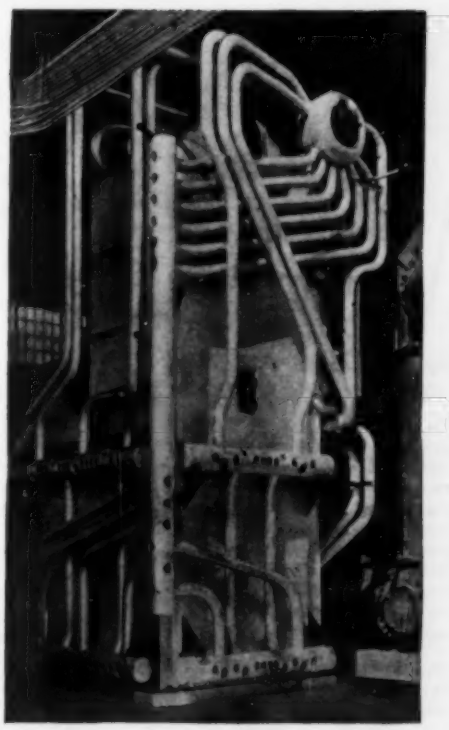
WASTE HEAT BOILERS

...for Contact Sulphuric Acid Plants

Waste heat boilers perform two important functions in the manufacture of sulphuric acid by the contact process. First, the necessary close control over temperature and rate of cooling is established; second, valuable steam is generated by the heat recovered.

Constructed to resist corrosion, tubes of these waste heat boilers are protected by a sheath of cast iron, and all joints are outside the gas passages. Extended-surface elements speed cooling of SO_2 gas, and reduce gas-travel distance through the elements.

When you have a heat-recovery problem, consult Foster Wheeler—specialists in all types of heat-exchanging equipment.



Specially-constructed waste heat boiler performs two functions—controls SO_2 gas temperatures and generates steam.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N.Y.

FOSTER WHEELER

CHEM. & MET.

Weighted Index of Prices for OILS & FATS

Base = 100 for 1937

This month	**145.80**
Last month	145.80
May, 1945	145.85
May, 1944	145.24

Chlorate, kegs, lb	$0.06½ -	$0.06¾
Cyanide, cases, dom., lb	.14½ -	.15
Fluoride, bbl., lb	.07 -	.08
Hyposulphite, bags, 100 lb	2.25 -	2.50
Metasilicate, bbl., 100 lb	2.50 -	2.65
Nitrate, bulk, ton	27.00 -	
Nitrite, casks, lb	.06½ -	.07
Phosphate, tribasic, bags, 100 lb	2.70 -	
Prussiate, yel., bags, lb	.10½ -	.11
Silicate, 40°, dr., wks., 100 lb	.80 -	.85
Sulphite, crys., bbl., lb	.02½ -	.02¾
Sulphur, crude at mine, long ton	16.00 -	
Dioxide, cyl., lb	.07 -	.08
Dioxide, tanks, lb	.04 -	
Tin crystals, bbl., lb	.39½ -	
Zinc chloride, grain, bbl., lb	.05½ -	.06
Oxide, lead free, bags, lb	.07½ -	
Oxide, 5% leaded, bags, lb	.07½ -	
Sulphate, bbl., cwt	3.85 -	4.00
OILS AND FATS		
Castor oil, No. 3 bbl., lb	$0.14½ -	$0.15¼
Chinawood oil, tanks, lb	.38½ -	
Coconut oil, Ceylon, N. Y., lb	.0885-	
Corn oil crude, tanks (f.o.b. mill), lb	.12½ -	
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12½ -	.12¾
Linseed oil raw, car lots, bbl., lb	.155 -	
Palm, casks, lb	.0865	
Peanut oil, crude, tanks (mill), lb	.12½ -	
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	.11½ -	
Menhaden, light, pressed, dr., lb	.13 -	
Crude, tanks (f.o.b. factory) lb	.089 -	
Grease, yellow, loose, lb	.08½ -	
Oleo stearine, lb	.09½ -	
Oleo oil, No. 1, lb	.11½ -	
Red oil, distilled, bbl., lb	.13 -	
Tallow extra, loose, lb	.08½ -	
COAL-TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.52 -	$0.55
Alpha-naphthylamine, bbl., lb	.32 -	.34
Aniline oil, drums, extra, lb	.11½ -	.12½
Aniline salts, bbl., lb	.22 -	.24
Benzaldehyde, tech., dr., lb	.45 -	.50
Benzidine base, bbl., lb	.70 -	.75
Benzoic acid, USP, kegs, lb	.54 -	.56
Benzol, 90%, tanks, works, gal	.15 -	
Benzyl chloride, tech., dr., lb	.22 -	.24
Beta-naphthol, tech., drums, lb	.23 -	.24
Cresol, USP, dr., lb	.10½ -	
Cresylic acid, dr., wks., gal	.81 -	.83
Diphenyl, bbl., lb	.15 -	
Diethylaniline, dr., lb	.40 -	.45
Dinitrotoluol, bbl., lb	.18 -	.19
Dinitrophenyl, bbl., lb	.22 -	.23
Dip oil, 15%, dr., gal	.23 -	.25
Diphenylamine, dr., f.o.b. wks., lb	.25 -	
H acid, bbl., lb	.45 -	.50
Hydroquinone, bbl., lb	.90 -	
Naphthalene, flake, bbl., lb	.07	.07½
Nitrobenzene, dr., lb	.08 -	.09
Para-cresol, bbl., lb	.41 -	
Para-nitroaniline, bbl., lb	.42 -	.43
Phenol, USP, drums, lb	.10 -	.11
Picric acid, bbl., lb	.35 -	.40
Pyridine, dr., gal	1.35 -	1.60
Resorcinol, tech., kegs, lb	.65 -	.70
Salicylic acid, tech., bbl., lb	.26 -	.33
Solvent naphtha, w.w., tanks, gal	.26 -	
Toluidin, bbl., lb	.96 -	
Toluol, drums, works, gal	.32 -	
Xylol, com., tanks, gal	.25 -	
MISCELLANEOUS		
Casein, tech., bbl., lb	$0.33 -	$0.35
Dry colors:		
Carbon gas, black (wks.), lb	.0365-	.097
Prussian blue, bbl., lb	.36 -	.37
Ultramarine blue, bbl., lb	.11 -	.26
Chrome green, bbl., lb	.23 -	.33
Carmine red, tins, lb	4.60 -	4.75
Para toner, lb	.75 -	.80
Vermilion, English, bbl., lb	2.50 -	2.60
Chrome yellow, C.P., bbl., lb	.16 -	.17
Gum copal Congo, bags, lb	.09 -	.55
Manila, bags, lb	.09 -	.15
Damar, Batavia, cases, lb	.10 -	.22
Kauri, cases, lb	.18 -	.60
Magnesite, calc., ton	64.00 -	
Pumice stone, lump, bbl., lb	.05 -	.07
Rosin, H., 100 lb	7.43 -	
Shellac, orange, fine, bags, lb	.46 -	
Bleached, bonedry, bags, lb	.42½ -	
T. N., bags, lb	.35½ -	
Turpentine, gal	.93½ -	.94¼

THOUSANDS of these "Buffalo" RUBBER-LINED FANS ARE CUTTING FUME-HANDLING COSTS

"Buffalo" builds special fans of all types; non-sparking, special metal, gas-tight, high pressure, high temperature, etc. Buffalo engineers are experienced in air handling for Industry. Get their recommendations on your fan requirements.

There is nothing new about the Buffalo Rubber-lined Fume Fan. Thousands of them are in use, handling fumes which quickly destroy metal but not rubber. In hundreds of plants, these tried and tested fans are giving from 3 to 13 times the service obtained from other fans.

Naturally, they cost more than substitutes, but on a "service" basis, they are cheaper than any other equipment.

If you handle corrosive fumes, write us today for our recommendation.

BUFFALO FORGE COMPANY

501 BROADWAY **BUFFALO, N. Y.**

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

RUBBER-LINED EXHAUSTERS

NEW CONSTRUCTION

	Current Projects		Cumulative 1946	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	$540,000	$1,908,000
Middle Atlantic	$140,000	$2,760,000	1,136,000	3,891,000
South	17,790,000	250,000	27,660,000	19,763,000
Middle West	2,090,000	1,844,000	11,218,000	36,604,000
West of Mississippi	25,115,000	9,886,000	70,955,000	32,423,000
Far West	940,000	580,000	2,255,000	7,524,000
Canada	.....	.....	405,000	14,863,000
Total	$46,075,000	$15,320,000	$114,169,000	$116,976,000

PROPOSED WORK

Ark., El Dorado—Lion Chemical Corp., El Dorado, plans to reconvert former Ozark Ordnance Works near here into a plant for the manufacture of fertilizer. Estimated cost $1,000,000.

Calif., Los Angeles—Felton Chemical Co., Inc., 4727 West Washington Blvd., plans to construct a 1 story, 80x140 ft. factory at Tennessee and Purdue Aves., West Los Angeles. Wiseman & Goldsmith, 629 South Hill St., Archts. & Engrs. Estimated cost $40,000.

Ga., Macon—Armstrong Cork Co., Lancaster, Pa., plans to construct a plant here. Harry Boettcher, Lancaster, Archt. Estimated cost $4,000,000.

Ga., Savannah—Southern Paperboard Corp., Savannah, plans to construct a mill for the manufacture of container board. Estimated cost $9,000,000.

Ill., Cicero—Socony-Vacuum Oil Co., 59 East Van Buren St., Chicago, plans to construct a blending plant and warehouse. F. L. Ockerlund, 59 East Van Buren St., Ch. Eng. Estimated cost $1,000,000.

Miss., Gulfport—Sterling Drug, Inc., plans to construct a 2 story factory here to contain 64,000 sq.ft. floor space. W. Stuart Thompson, 125 East 41st St., New York, N. Y., Archt. Estimated cost, fully equipped, $600,000.

Mo., St. Louis—Insull-Wool Insulating Co., 3903 Olive St., plans to construct a factory and warehouse building at Olive Rd. and Hayes Ave. Estimated cost $40,000.

N. Y., Brooklyn—Kinsey Distilling Sales Co., Inc., 1429 Walnut St., Philadelphia, Pa., plans to convert boiler room into warehouse. W. Bigginson & Son, 101 Park Ave., New York City, Archt. Estimated cost $50,000.

O., Heath—Pure Oil Co., Heath (near Newark) plans to rebuild its gasoline cracking unit recently destroyed by fire with a loss of $1,000,000.

O., Salineville—Caldean China Co., Salineville, plans to install a tunnel kiln in its plant here. Estimated cost between $40,000 and $50,000.

Ore., The Dalles—Northwest Chemurgy Co-operative, Wenatchee, Wash., plans to construct a 6 story, 90x250 ft. starch plant and two 3 story buildings for the production of dextrose and glucose. R. Beck, Olympic Hotel, Seattle, Wash., Cons. Eng. Estimated cost $900,000.

Pa., Philadelphia—American Fibre Paper Board Co., 12th and Jackson Sts., plans to construct a factory. L. Magaziner, 1701 Walnut St., Archt. Estimated cost $45,000.

Pa., Philadelphia—Gulf Oil Corp., Refinery Div., 30th St. and Penrose Ave., plans additions to its refinery facilities. Estimated cost $45,000.

Tenn., Elizabethton—North American Rayon Corp., Elizabethton, plans conversion of manufacturing building, Unit No. 3. Moran, Proctor, Freeman & Mueser, 410 Lexington Ave., New York, N. Y., Eng.

Tenn., Nashville—Ferro Enamel Corp., 41 East 56th St., Cleveland, O., plans to construct a factory here. Estimated cost $150,000.

Tenn., Oak Ridge—Monsanto Chemical Co., 1700 South 2nd St., St. Louis, Md., plans to construct addition and complete extension of Clinton Laboratories here. Dr. Charles Allen Thomas, Vice Pres. and Technical Dir. Estimated cost $2,500,000.

Tex., Benevides—Sun Oil Co., Milam Bldg., San Antonio, plans to construct pressure maintenance plant in Weil Field. Estimated cost $100,000.

Tex., Cedar Lake—Stanolind Oil & Gas Co., Fair Bldg., Fort Worth, plans to construct gas plant and pressure maintenance facilities for conserving casing-head gas. Estimated cost $2,225,000. Also one in Goldsmith area to cost $7,000,000.

Tex., Houston—Acme Brick Co., 2203 Polk St., plans to construct manufacturing buildings. Estimated cost $100,000.

Tex., Houston—Clorox Chemical Co., Oakland, Calif., plans to construct plant buildings and warehouse on 3½ acre site just purchased. Estimated cost $150,000 and $50,000 respectively.

Tex., Midland—Frontier Chemical Co., Midland, plans to construct a chemical plant. Estimated cost $500,000.

Tex., Midland—Shell Oil Co., Inc., Shell Bldg., plans to construct a natural gasoline manufacturing plant. Estimated cost $2,500,000.

Tex., Midland—Stanolind Oil & Gas Co., Fair Bldg., Fort Worth, plans to construct plants and pressure maintenance facilities for conserving casinghead gas in Foster Field, Fullerton Field, North Cowden Field, South Cowden Field and Slaughter Field. Estimated cost $10,450,000.

Tex., Spearman—Panhandle Eastern Pipe Line Co., Box 148, Stinnett, plans to construct a gas compressor station. Estimated cost $750,000.

Tex., Wichita Falls—Continental Oil Co., Wichita Falls, plans to expand and modernize existing refinery plant. Estimated cost $250,000.

Va., Richmond—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., Wilmington, Del., plans to construct a sulphuric acid plant on the James River between Bellwood Rd. and Kingsland Creek, Bellwood, about 9 mi. from here to be operated by Grasselli Chemical Div. Estimated cost $1,500,000.

CONTRACTS AWARDED

Ark., El Dorado—Lion Oil Co., El Dorado, has awarded the contract for constructing a catalytic cracking unit at refinery here to Lummus Co., Esperson Bldg., Houston. Estimated cost $1,250,000.

Calif., Pasadena—Allied Products, Inc., Division St., Suffern, N. Y., has awarded the contract for a 1 and 4 story cosmetic factory at Foot Hill Blvd. near Eaton Wash, to Wm. Simpson Construction Co., 816 West 5th St., Los Angeles. Estimated cost $500,000.

Calif., Sacramento—Cobbledick-Kibbe Glass Co., Washington and 3rd Sts., Oakland, has awarded the contract for the construction of a warehouse to Campbell Construction Co., 800 R St. Estimated cost $40,000.

Calif., South San Francisco—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., Wilmington, Del., has awarded the contract for an addition to its thinner plant here to Western-Knapp Engineering Co., 7560 Folsom St., San Francisco. Estimated cost $40,000.

Ind., Indianapolis—Citizens Gas & Coke Co., 49 South Penn St., has awarded the contract for an addition to its gas producer plant to Wilputte Coke Oven Corp., 40 Rector St., New York, N. Y. Estimated cost $1,123,870.

Mich., Detroit—Park Chemical Co., 8074 Military St., has awarded the contract for an addition to its plant to Barton-Malow Co., 2631 Woodward Ave. Estimated cost $75,000.

N. J., Trenton—Trenton Potteries Co., 309 North Clinton Ave., has awarded the contract for a 1 story, 200x250 ft. factory building to Fowler-Thorne Co., 211 North Montgomery St. Estimated cost $120,000.

N. Y., New York—Pathe Industries, Inc., 625 Madison Ave., has awarded the contract for a film laboratory, offices and storage rooms at 100-116 East 107th St., and Park Ave., to Diesel Electric Co., Inc., 2 Park Ave. Estimated cost $600,000.

N. C., Winston-Salem—The Duplan Corp., Hazelton, Pa., has awarded the contract for a factory building here to Fowler-Jones Construction Co., Charlotte. Estimated cost $250,000.

O., Cleveland—Cuyahoga Soap Co., 808 Denison Ave., has awarded the contract for rendering house and boiler house additions to John Hoelzl Construction Co., Hanna Bldg. Estimated cost $45,000.

O., Toledo—Standard Oil Co. of Ohio, 3083 Broadway, has awarded the contract for oil separation and skimming plant on East Bay Shore to Curro Construction Co., Union Commerce Bldg., Cleveland. Estimated cost including equipment $600,000.

Pa., Bridgeport—Daring Paper Co., Second and Merion Sts., has awarded the contract for rebuilding its paper mill recently damaged by fire to Albert W. Walker, 20 West Freedley St., Norristown. Estimated cost $40,000.

Pa., Bridgeville—American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York, N. Y., has awarded the contract for two factory buildings here to Martin & Nettrone Contracting Co., Pitt National Bank Bldg., Pittsburgh. Estimated cost $2,000,000.

Tex., Alvin—Stanolind Oil & Gas Co., Gulf Bldg., Houston, has awarded the contract for a gas plant to Stearnes-Rogers Co., Union National Bank, Houston. Estimated cost $2,500,000.

Tex., Houston—Shell Oil Co., Shell Bldg., has awarded the contract for the construction of a 2 story refinery building to Austin Co., Second Natl. Bank Bldg. Estimated cost $136,000.

Tex., Houston—Shell Oil Co., Inc., Shell Bldg., has awarded the contract for a lubricating oil manufacturing plant to Lummus Co., Esperson Bldg. Estimated cost $6,000,000.